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# AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 31. 505 PEARL STREET, NEW YORK. No. 39.

Index to Advertisers and Classified Index Following Reading Matter.

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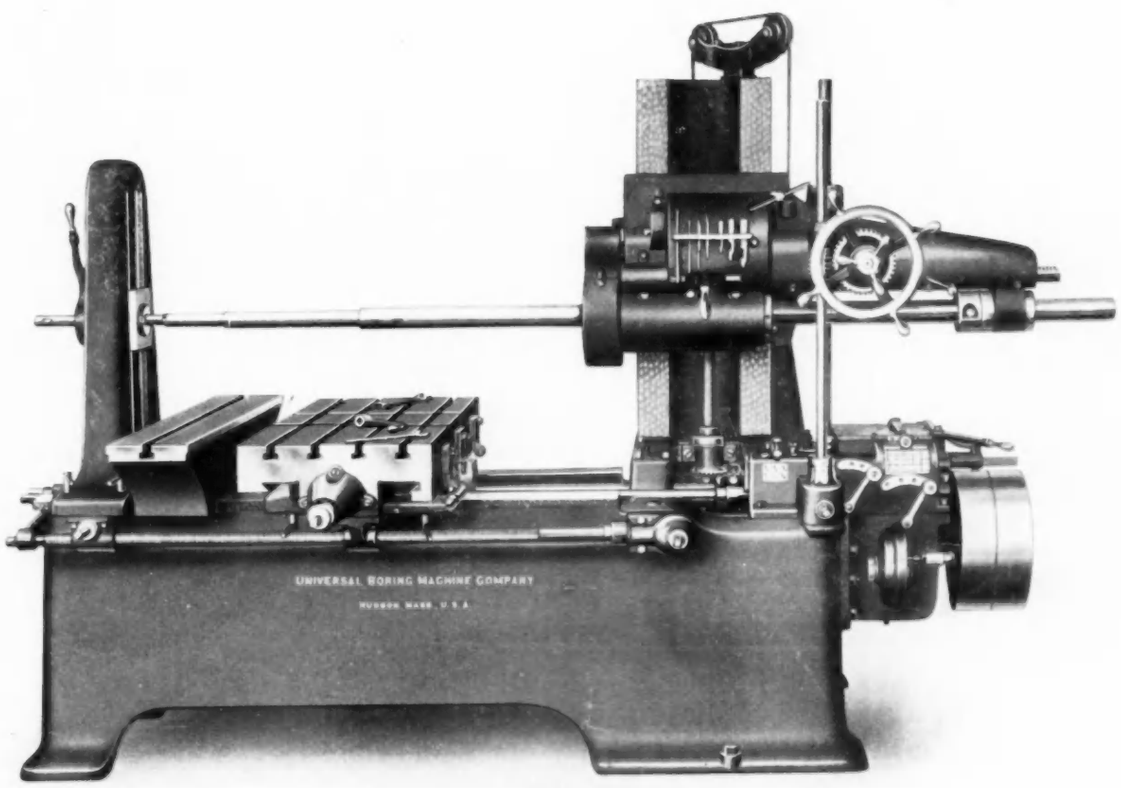


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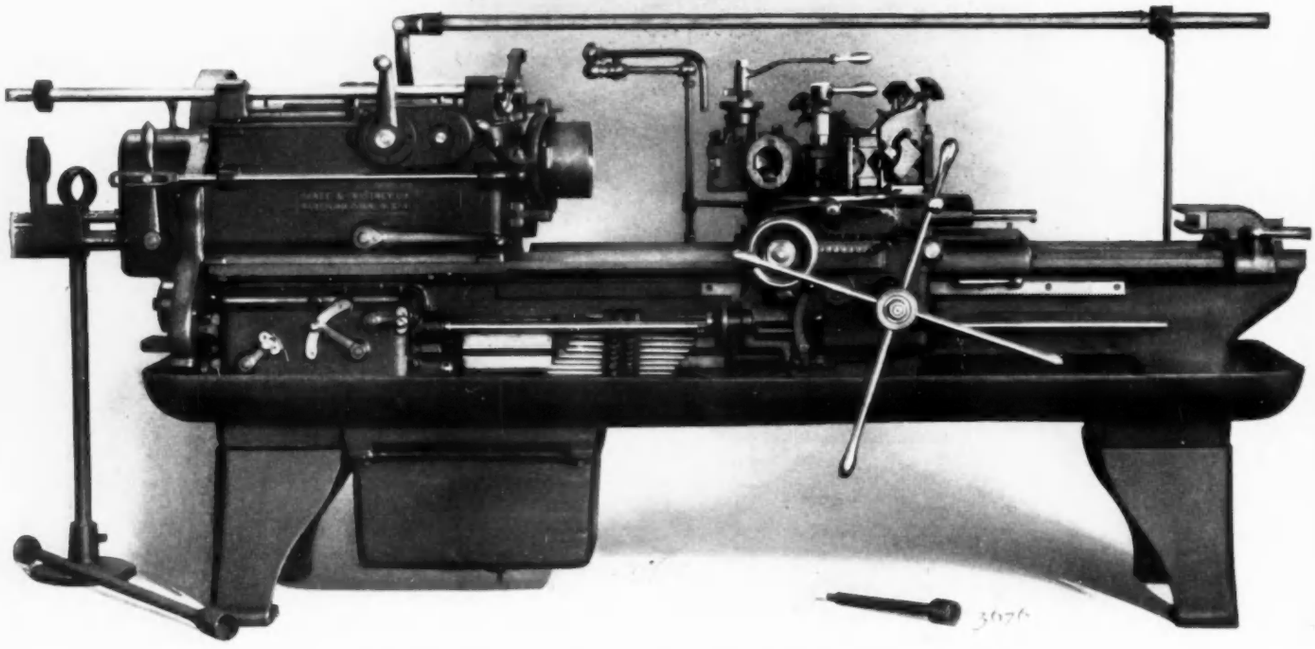

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# Machining a Large Segmental Gear Wheel

## Simple and Ingenious Method of Indexing the Teeth for Machining. Operations on Planer, Boring Mill, Slotter and Portable Miller

BY C. SCHOLTKA*

The Nordberg Manufacturing Company, of Milwaukee, Wis., nas recently made some large gears and drums for the hoisting machinery that it builds, which are to be shipped to Cuba with the completed machines. The machining operations on these gears are very interesting and for that reason these have been gone into in detail.

The drums are used to wind cables on, and the drum and gears, one of which is bolted to each side of the drum, are shown assembled in Fig. 1. The outer flanges, on the drum, form a shroud on the inside of each gear. The drum is cast in four segments, which are fastened together as shown, and the gear teeth are cast on a rim which is in eight segments. Extra segments of both the gears and the drum are furnished with the machine, hence each piece has been made interchangeable, in case any segment should have to be renewed from breakage or undue wear.

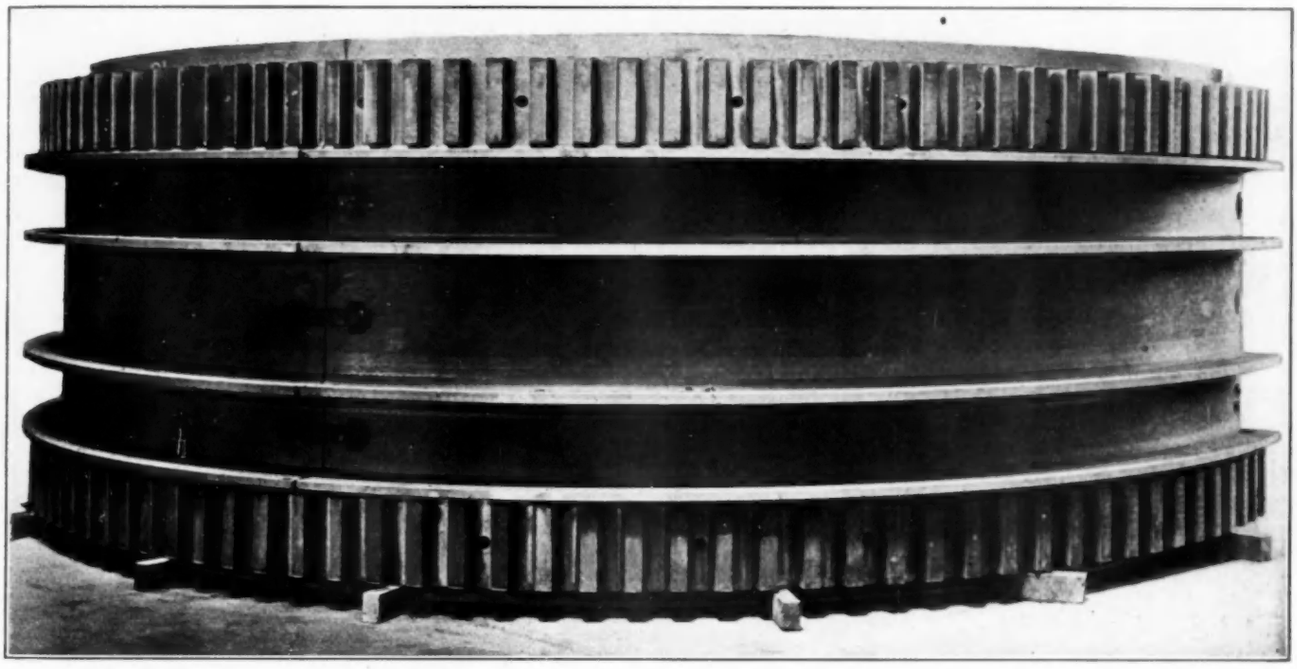

FIG. 1. GEARS IN DRUM MADE IN SEGMENTS AND ASSEMBLED

### Planer Operations

The first operation in machining the gear-wheel segments is to lay them on their side on the planer and spot the face of the three center teeth, with a tool in the side head, so as to form a flat surface for a bearing on the planer bed as this gives a ready means of clamping them for the next operation.

The second operation is to clamp four of the segments to the planer bed, as shown in Fig. 2, and finish the outside with the tools in the side heads. This gives a flat surface from which to work in the operations which follow. While this is being done the tongues on the opposite sides, or those next to the center of the planer bed, are being spot-faced by tools in the two main heads of the planer, so as to give flat surfaces for the straps used in clamping them for subsequent operations. This inside surface is finished later when boring and turning them in the boring mill.

The third operation is to plane the ends of the segments. In this operation the eight segments, which form the circle, are clamped to the planer bed, as shown in Fig. 3, and both ends of the eight segments are planed at the same time. Before clamping the segments to the planer, they are scribed to the shape of the templet, shown on the end of the bed of the planer, and when setting them up on the planer bed they are lined up to these scriber marks to insure the proper amount of stock all around for finishing.

When the ends are planed off grooves are cut, in both ends of each segment, that are ¼ of an inch wide and ⅛ of an inch deep. These grooves receive a square ¼ inch cold-rolled steel rod which acts as a feather to interlock the segments.

### Boring-mill Operations

The fourth operation is performed on a boring mill and when the work reaches this stage, the eight segments that form the complete circle of the gear wheel are clamped to a spider that is centered on, and fastened to, the platen of the boring mill with the flange or tooth side up, as shown in Fig. 1.

This spider has teeth stocked, and when the segments are located on the spider, they are clamped to prevent them from moving, by straps which fit between the teeth, which are only stocked, or roughed out, and are bolted to the spider, as shown in the front of the boring-mill table. This leaves all the surfaces unobstructed that are to be machined on the boring mill.

This fourth operation consists of three parts, the first of which is to bore out the inside of the rim so the gear wheels will fit on the ends of the drum, as shown in Fig. 1; the second part is to turn off the top of the gear wheel as it lies on the spider. This side of the gear has a tongue turned on it that fits in a groove, which is turned in the flange of the drum, and this prevents the gear segments from working out of position when the gears and drum are in operation; the third part

*Superintendent, the Nordberg Manufacturing Company.

is to face off the outside diameter of the teeth to their correct size.

### Operations on Slotting Machine

As these gear wheels were nearly 20 feet in diameter; the pitch diameter being 19 feet and 6 inches with 120 teeth that have a 12-inch face, no machine was available that had been designed with a large enough capacity to cut the teeth.

This made it necessary to devise ways and means of doing the work on smaller machines, and after considerable headwork we decided to cut the teeth on machines which were out of all proportion to the size of the gear wheels or the teeth. To add to the complications the teeth were cut on a bevel of 26 minutes and 51½ seconds, the drum shafts being that much out of horizontal to allow for the passing of the ropes on the drums.

The fifth operation was performed on the slotter and consisted of stocking the units of the gear wheel as illustrated in Figs. 5 and 6. The jig on which the segments are held for this stocking operation is tapered to give the proper angle of 26 minutes and 51½ seconds to the teeth.

The bottom of the tooth is cut to depth on the slotter, with one cut, to prevent the milling cutter from cutting on its end when finishing the balance of the tooth.

### Appliance for Forming Teeth

A special cross-feed screw *A*, Fig. 6, was made for the slotter and this was fitted with some simple appliances, that automatically fed the table sideways, while it was feeding outward, so that the tool *B* would cut the tooth with the proper compound curve to make it an involute one.

This cross-feed screw was made extra long so it would hold the coil springs *C*, which are located on opposite sides of the table. The springs are given the proper tension by the adjusting nuts *D*. The thrust collar, that is usually located under the platen *I* is left off of this feed-screw and the piece *E* is made to take its place. This is hinged on one side by passing a bolt through it, and when swung down in place, as shown, it fits into a groove, turned in the feed-screw, thus allowing the platen to be fed sideways, in the usual manner, when finishing the surface between the root of the teeth, or doing any other kind of work. At *H* is located a former, which is given the shape that one side of the teeth should be, when finished, and on the other side of the platen *I* is another former for the opposite side of the tooth. A triangular-shaped block or pointer is bolted to the side of the platen, and the point of this is held against the former *H*, by the coil spring *C*, when the platen is being fed out, thus causing the tool *B* to cut the tooth to its proper shape.

When one side of the tooth is being machined, the adjusting nut *D* is screwed in to give the spring its proper tension and thus force the platen against the former on the opposite side, and when the other side of the tooth is to be machined, this nut is screwed out to release the spring, and the nut on the opposite side of the platen *I* is screwed up to give tension to its spring and the platen is held against the opposite former, as it is being fed out, while the tool *B* is cutting. When a tooth is machined the segment *L* is moved around on the jig *K* to the next tooth so it can be machined.

In roughing out the teeth on this slotter, 1/16 of an inch of stock is left for

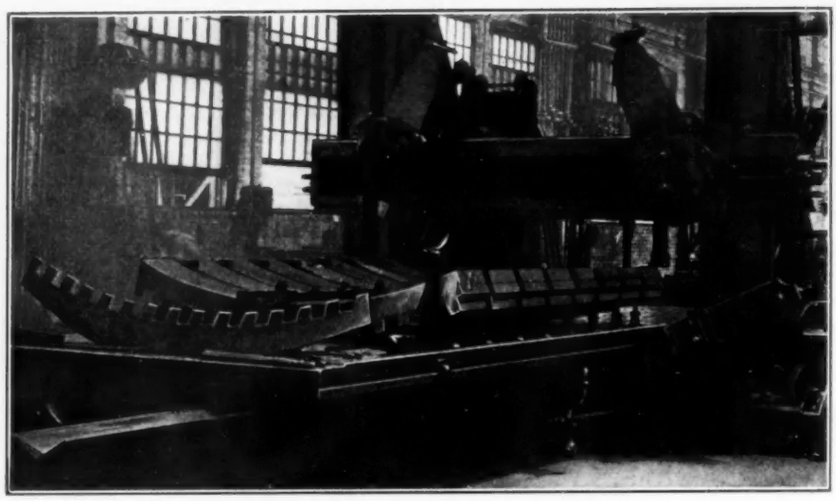

FIG. 3. PLANING ENDS AND CUTTING GROOVES IN SEGMENTS

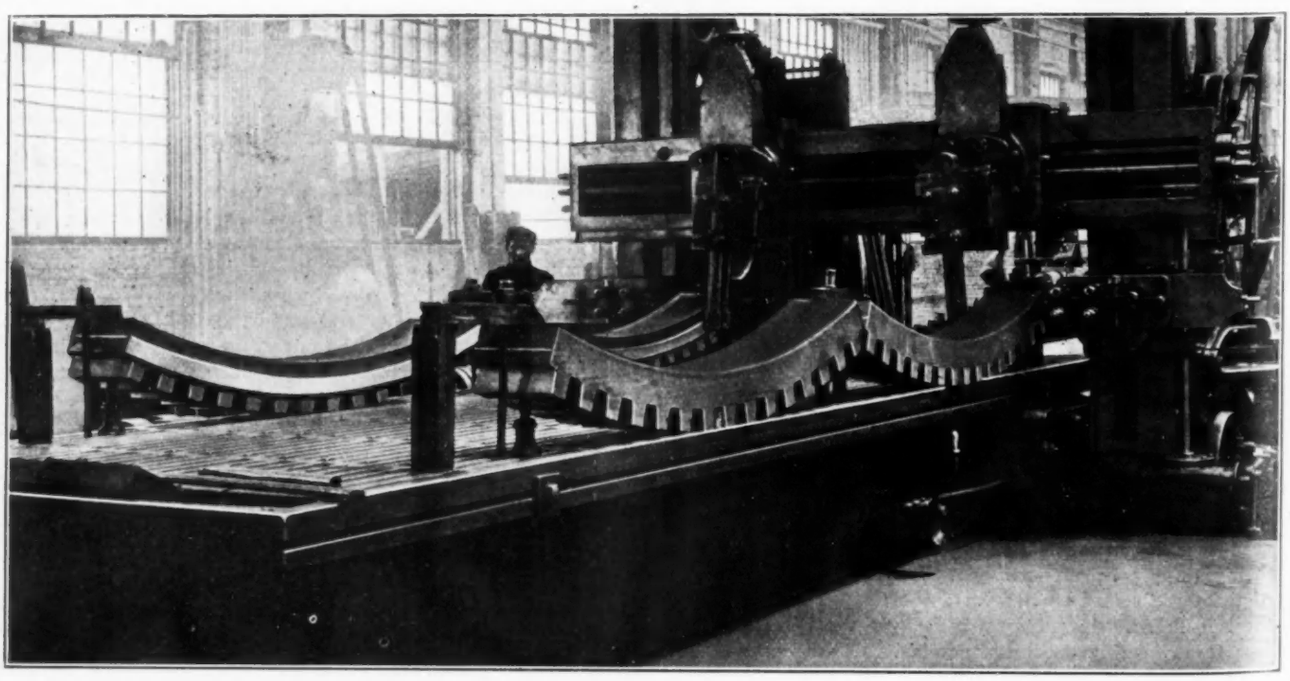

FIG. 2. PLANING OUTSIDE AND SPOT FACING INSIDE OF GEAR WHEEL SEGMENTS ON LARGE PLANER

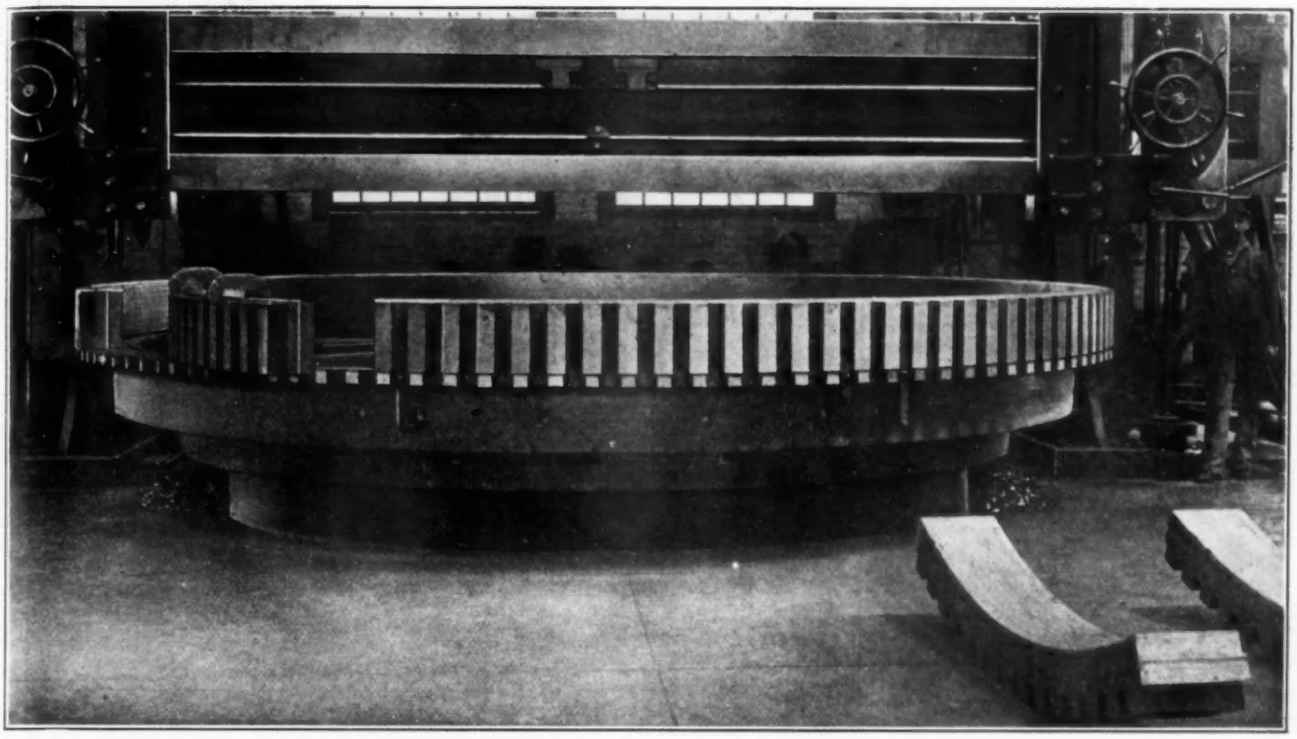

FIG. 4. CLAMPING SEGMENTS TO SPIDER FOR BORING, TURNING AND FACING ON THE BORING MILL

the milling cutter to take off in the final operation.

### Operations on Portable Miller

The sixth and final operation is the finishing of the teeth by milling them on a portable miller. The job is shown set up, ready to begin work in Fig. 7 and its size is shown by the 10-foot pole which is lying across the hub in the center. Its size, as compared with the size of the machine, is shown by the parts of the machine which are seen in the illustration.

The gear is clamped on the same spider that is used on the boring mill, as shown in Fig. 4, but with the flange down. The spider was reversed for this operation so the rim would be on the top, this rim being the same diameter as the drum to which the segments are finally bolted. After bolting, the gear was laid out, special pains being taken in doing this. A double pointer was bolted to the milling machine to insure accuracy, after which the cutter was fed down through the segments and spider, leaving the teeth a little above size. They were then tested and finding them within the limits, the finishing cut was taken (about 10 minutes per tooth). This made an index upon which the balance of the segments were finished with one cut, there being eight gears of the spider in all to machine. This spider serves as an index by revolving it on the stand that rests on the end of the bed plate of the miller, and six rollers that are placed under its rim. The bed plate, as will be seen, is just long enough to hold the port-

FIG. 5. SEGMENTS OF GEAR IN ITS JIG ON THE SLOTTER READY TO ROUGH OUT THE TEETH

able miller on one end, and the stand that supports the central hub of the gear spider on the other end. A plate with the proper taper was placed under the milling machine to tilt it to the proper angle for machining the teeth.

The milling cutter is made full size, so it will cut both sides of the teeth when it is fed downward, and the hand-wheel *M* in the foreground of Fig. 8, is used to index the gear over to the next tooth, by making the block *N* press against one of the teeth and revolve the gear with its spider until it comes to the right position. This is ascertained by a gage, on the bottom end of the lever *O*, that swings up between the teeth on the spider, these teeth having already been cut to the exact size and shape. This gage is located exactly under the milling cutter *P*.

If the gear should be shifted too far it can be forced back by turning the nut in the block *R* in Fig. 9, which is a view of the back of the miller. The lever *S* is used as a latch to hold the gage in position while working on this side of the machine. This indexing mechanism is better shown, as it is being used on the pinions, in Fig. 10, the man to the left having his hand on the shifting wheel.

The pinions being smaller, can be machined, two at a time, by placing one

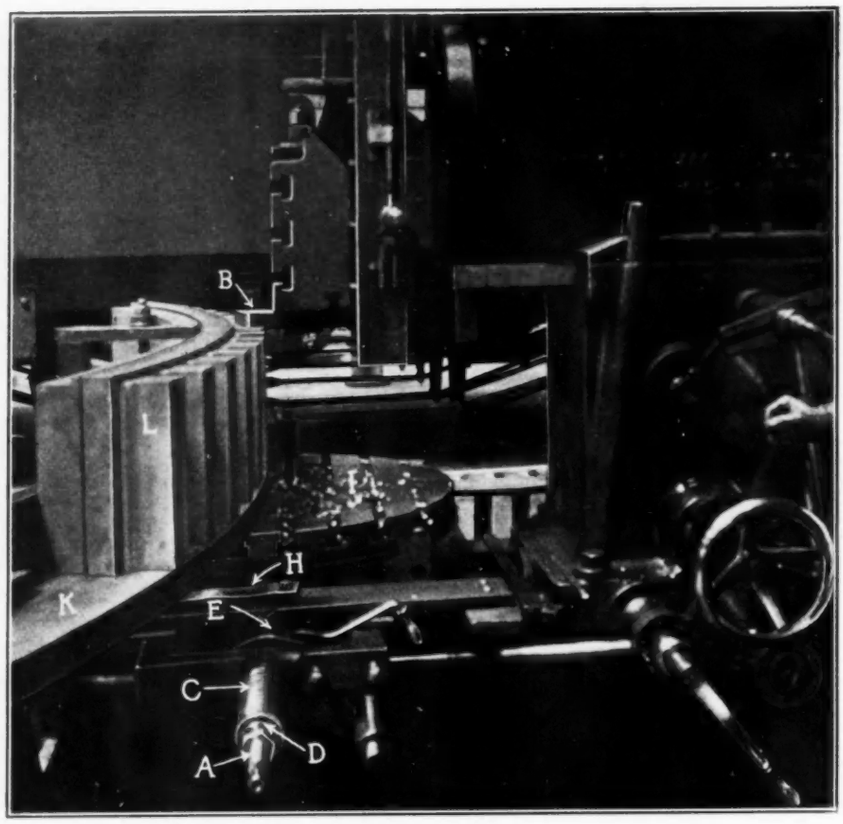


FIG. 6. THE TOOL IN POSITION TO ROUGH OUT THE TEETH

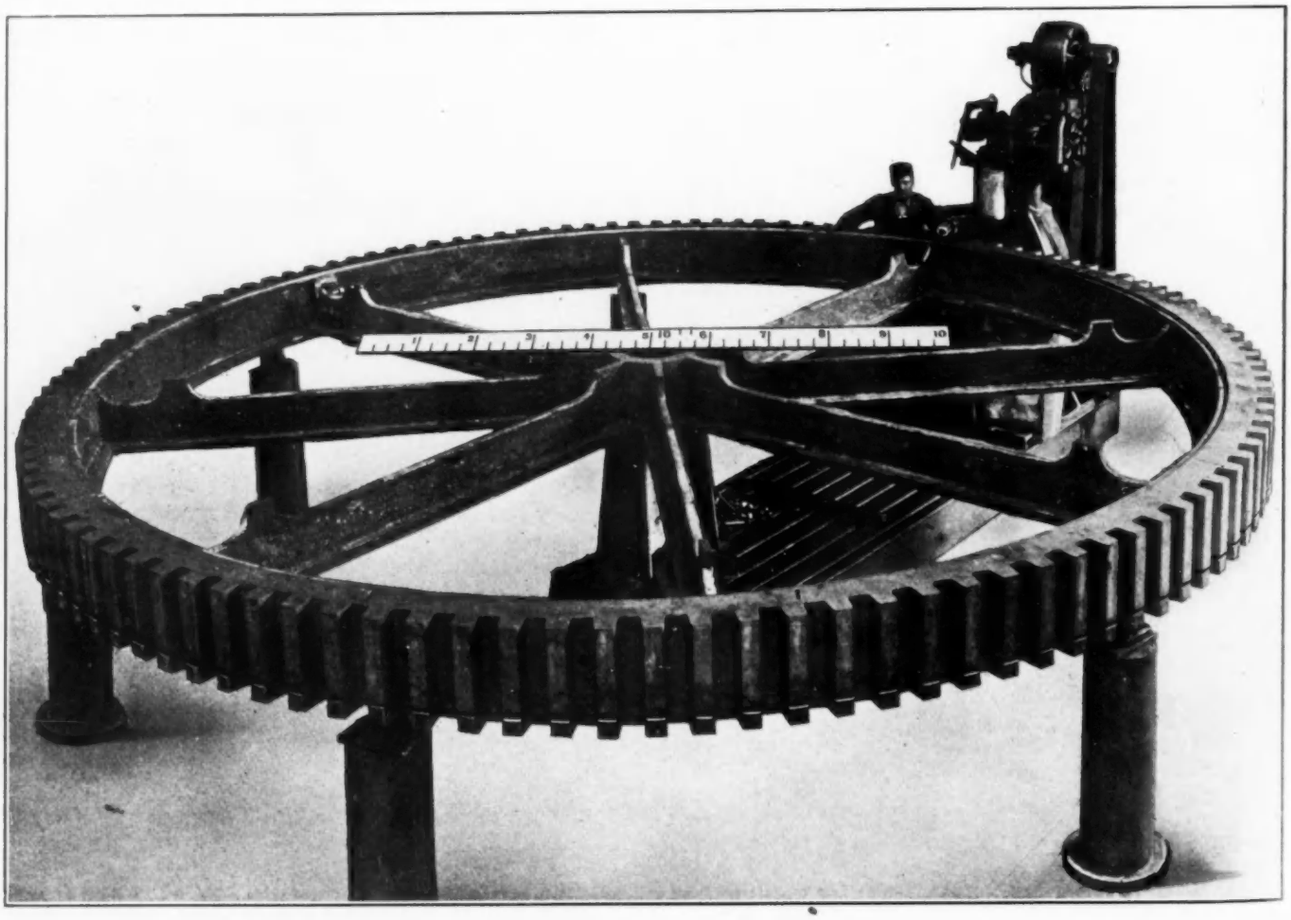

FIG. 7. GEAR SET UP ON PORTABLE MILLER READY TO FINISH THE TEETH

on top of the other and mounting them on the platen of a milling machine, as shown in Fig. 10. The pinions are 4 feet 10½ inches pitch diameter, with 30 teeth, a face 12 inches wide, and a circular pitch of 6⅛ inches.

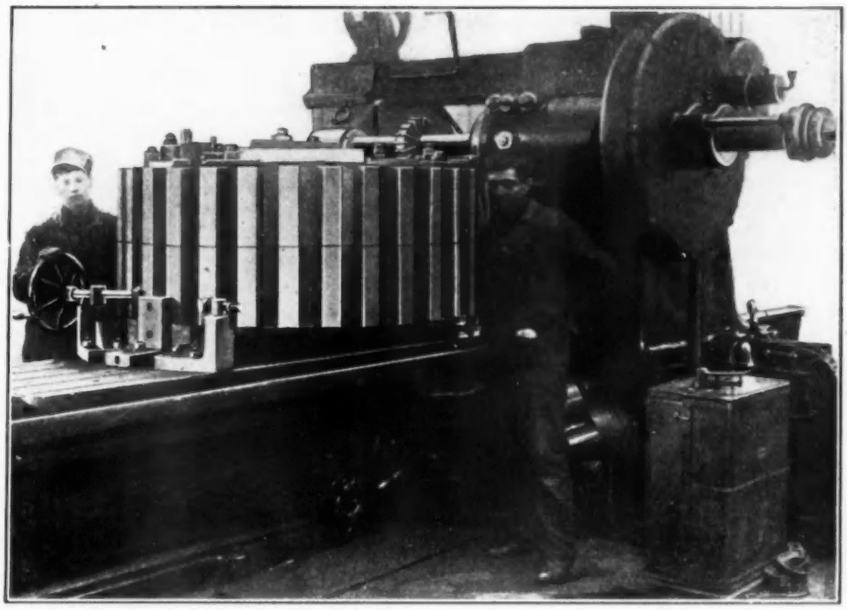

FIG. 10. MACHINING THE PINIONS TWO AT A TIME

## Sammy's Shop—The Personal Equation

By W. Osborne

The working force had been gathered together one at a time as more help was needed until it had gotten to its present size. Everybody knew everybody else and the best of feeling prevailed. It was very desirable that it should be so, for with the conditions under which the work was done it often happened that two men were on the same job or had to do one another's work. While this was true of the shop work it was also true of the office work and to even a greater extent. The bookkeeper would help the shipping clerk, or take his place for a day if necessary, and the shipping clerk would write orders and figure up invoices when he had the time, or give a hand to the cost clerk if it was needed.

Sammy acted as purchasing agent when present while the bookkeeper did it when he was not. The requisition book was kept up jointly by the heads of the departments using the material needed. This term "department" looks large in print; larger really than the conditions warrant. The way it worked was this: If the head blacksmith saw that his supply of coal, or his stock of iron or steel, was getting lower than he thought it should be he told the first office man that he happened to see when he was thinking about it. The man told, if he did not forget, put it into the requisition book. Sammy saw it there and perhaps went and looked over the stock himself and then ordered ac-

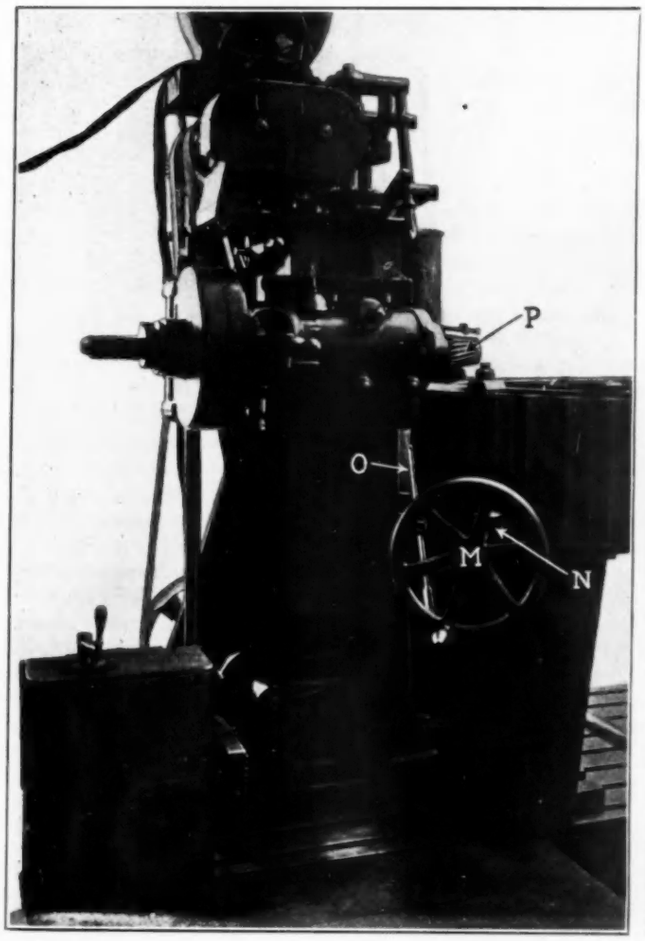


FIG. 8. FRONT OF MILLER SHOWING INDEXING APPARATUS

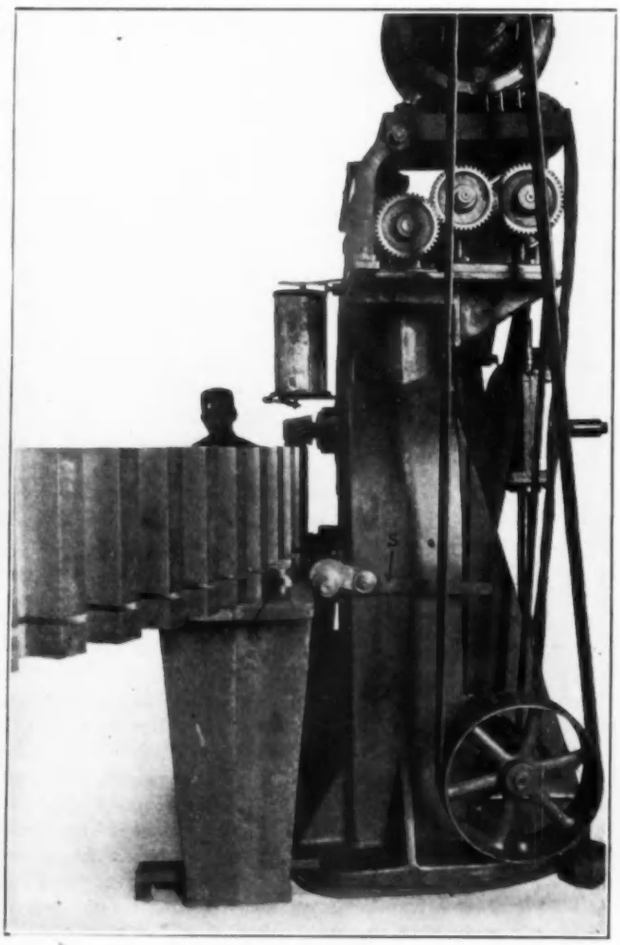

FIG. 9. BACK OF MILLER SHOWING INDEXING APPARATUS

cording to what his judgment indicated. If any new work came in that required a size of iron not usually kept in stock and this was recognized in the office a note of the fact would be made in the requisition book. As soon as the blacksmith got the order he would look over his stock and seeing a lack he would notify the office, this notifying the office meaning, as before, that he had told some one of the men working in it. The other men taking the lead in the work acted in the same way.

Such system as there was had been the outgrowth of the conditions. At one time Sammy had been able to carry it all in his head, but as the business grew his head was not large enough and he had to have other heads to help carry things. As several heads had to know the same things and as they were not always at hand when wanted books were used. This requisition book was one of them. With everybody interested in making things go, and friendly to everyone else the business ran along smoothly; it was not realized that the system was not up-to-date.

Gradually it had gotten so that there was more office work than the force could keep up with and Charley was taken on.

### Charley

Charley was a young man who had received his business training under different conditions than those which existed in Sammy's shop. He had worked in a place where a man had duties which were very clearly defined. Inside of the boundaries he must attend to everything and outside of them he must not touch anything. This training had been given to a nature that was naturally methodical and ambitious, and under conditions where the chances for advancement depended largely on having a clear record. Under these conditions a man's whole interest was concentrated on having his own work so that it was all on record and the records unimpeachable, regardless of how it might harmonize with anything else. It amounted to getting orders and obeying them.

In his new place he did not have clearly defined duties, but was expected to work wherever he was needed and he took hold with a will. It did not take him long to point out that a little more system would save work and mental worry, and incidentally, if things did go wrong, would show where the blame belonged.

Before long it was so arranged that the blacksmith (this was common to all heads of departments) had to report stock needed on a slip of paper and was held to be responsible if he did not do so in time. Charley was a hustler and seemed to be able to cover more ground in a day than anyone else about the place, and as most of the new departures started with him or from suggestions which he made it was very natural that he took more interest in them than the others did; so he did most of the pushing that kept them going. He was careful to point out to any delinquent the enormity of his offense when things went wrong, often, I fear, in a much more severe way than the circumstances justified, or than he realized he was doing.

It gradually came about that a certain amount of ill feeling developed; on a number of occasions Sammy had to pour oil on the troubled waters. It was soon found that system begets system and some of the offspring may turn out to be black sheep. Take the case of the blacksmith for example. His work was not done under conditions that made it convenient to write at all times and when his hands were clean enough to write he did not always think of the sizes of stock which he might need. Under the old conditions he could tell his wants to Sammy or to any of the office force and if the stock did not come in time they at least shared the blame.

Now he was the culprit, and if, to save himself, he tried to use some other sized stock he was asked to explain why it took so much time to do the work.

### The Blacksmith and the System

Finally he got "on the war path," as the boys say, and declared that he was willing to do the blacksmithing, but that someone else would have to do the running of the system. "If this thing keeps on piling up like it has been for a while back it will be a college professor that you will have to get to do what you want instead of a blacksmith." That was the way he expressed his view of the situation to Sammy.

"You use the iron and know more about it than anyone else about the place, it is right here near you, and besides that you have always looked after it and done it well. I don't see any reason that we should make any change," said Sammy.

"That was all right once, but things are different now; things are very different now."

While he did not say so, Sammy had to admit to himself that things were very different; still, it was part of his business to keep them running smoothly and he tried to have the blacksmith see it from his standpoint.

He could, of course, have taken the stand that this man must do as he was told to or leave, and then he would have been looking for another blacksmith. He thought it would be easier to convince this one than to find a better one.

After some talking the blacksmith agreed to look after the stock up to a certain extent.

"When I get a list showing every size you want kept and the number of bars I am to call for at once and how many bars I am to have on hand when I call for more, then I will begin to look after it."

That sounded reasonable enough until the office undertook to make out the list. This shop was not a manufacturing shop and a record of the sizes and quantities used in the past was not a sure forecast of what would be used in the future. It was not very satisfactory when done, for it was a compromise between the effort to not tie up too much money in stock and an attempt to have enough stock on hand to meet any conditions that were likely to arise.

The blacksmith surveyed it with a sarcastic grin. The same day the office received a requisition from him for some stock. Things were so systematized by this time that it was ordered without Sammy having seen the list, but he did see the stock when it began to come in. Never since he had been in business had he had such a supply on hand. The racks would not hold it, and it had been gotten on the requision of the blacksmith, so the clerk who had ordered it informed him.

"Yes, sir; I ordered it. There is the list I got to work to, and if you don't like it you just go after the man who made the list out."

The tone and manner were far from friendly, but the matter was serious and Sammy took the list and went into the office.

Charley had made out the list and he showed that all of the sizes on the list had been used before. He had been checking over the invoices and showed that stock had been called for and received that was not on the list, and in several cases more had been called for than the list authorized. He pointed this out to the blacksmith in very plain terms and gave him to understand that the list would have been all right if he had used it as he had agreed to.

He did not reply to Charley, but turning to Sammy he said: "I will not interfere again as long as you have such a competent fellow looking after things for you."

It turned out afterward that the stock which was not on the list was needed for some orders already in the blacksmith's hands and where he had ordered more than the list called for the excess was also needed at once.

Some time after this an order came in that required a lot of forging. It was wanted in a hurry, and after a little a call for one size came from the blacksmith shop. In a couple of days a call came for another size and the following day a call came for two sizes. The day after the first size came a call came in for some more of the same size and Sammy saw it and went to the blacksmith to find out about it. He found that it would take about three more lots of that size to finish the order, and that the forgings would cost much more than they would have done if all the stock had been on hand before the work was started.

"I never knew you to get mixed up like this on an order before," said Sammy, when he had found out the state of affairs

"I'm not mixed up," snarled the blacksmith. "I am following instructions, and obeying orders. There is the list. I followed it."

"List or no list, I expect you to use your brains, and when you know—" He did not get any further. The blacksmith had thrown down his hammer and taken off his apron and thrown it on the hammer. "Don't talk to me of brains," he shouted, as he shook his fist in Sammy's face. "Where are your brains? You think that the only man in the place who has any brains is that Charley. I'm through here and will try to find a place where they want more than one man with brains." So angry was he that it was useless to try to talk to him, and before he had calmed down he had rolled up his personal belongings and left.

### What Caused the Dissatisfaction?

So many things are happening around a works that it is not always easy to divide them into the classes where they belong. Sammy had noticed that a number of men had quit lately. Of course there is nothing strange about a man getting tired of a job and quitting, or of one thinking that he could do better in some other place, or for one to see that he is not making good and dropping out ahead of the time that the foreman will have to drop him. A certain amount of this can go on and not attract any attention to indicate that there is any extraordinary cause for it.

When the blacksmith quit in the violent way that he did it set Sammy to thinking about the other men who had quit, and he got to wondering why they had quit. While he was trying to solve the combination one of the men that he knew well and who had worked for him for a long time, gave notice of his intention to quit on the coming pay day. Sammy pressed him for a reason.

"It isn't the shop it used to be, some way or another. I don't have any particular kick coming, but when I don't like a place I get out." This was not definite. There was dissatisfaction sure enough, but the reason was not apparent. Sammy wanted something more definite.

"I don't know as I can tell you just why things are different from what they used to be, but I know they are. Why, once the men were all friendly to one another, and they tried to help one another, and now it seems as if everyone about the place was trying to cut the throat of everybody else. It may be because the works are getting bigger, but if that is the reason I never want to work anywhere but in small shops." From this it would seem that while this man had felt a change in his surroundings in the shop, he had not analyzed down to the cause.

Sammy had always rather prided himself on the fact that steady, desirable men liked to work for him, and that they were not the kind that kept dropping out. This pride got considerable of a jolt, for it was his best men that he was losing, and the most that he could find out was that the entire force seemed to be restless and dissatisfied and that it seemed to center around Charley and the systems. He went over the new things and could not see but that the object aimed at was a proper one. Experience might show that some of the ways that were being tried would have to be modified or abandoned because they did not produce the desired results, but that was true of many new things that had been tried before. Even if the results were poor the loss was on him and his associates; why should the men object? In talking to them they all disclaimed having any objection to his trying any kind of a system that he might wish to.

It may be that David felt an unholy glee when it was shown that the reason that a customer's work was wrong was because Charley got the order wrong, and not because he got his sizes wrong; it is altogether likely that he let his feelings show through. The trouble had been blamed on him, and it was his vehement insistance that he was not wrong in his work that led to the discovery that this was a slip of Charley's.

A number of others besides David seemed to be pleased to find that it was possible for Charley to make a mistake, even if it did make Charley set his teeth together and speak even sharper than was his usual habit.

It was not long after that until David did make a blunder, and it was made in such a way that there was no use in dodging. It was serious enough so that everybody knew of it. It even came out that Charley, in a very sarcastic manner, had warned him that he was mixing things. After that warning Charley had let him go ahead and spoil the job without any further attempt to interfere, for it was not part of his work to look after David; at least so he said. There was no question but that he took delight in bringing out every point that would make it disagreeable for David, and that he had a personal grudge against him because of the former mistake.

### The Kind of Man that is Needed

Sammy kept David, but has another man in the office in the place of Charley. Charley had some peculiarities. Some of the points of system introduced under him were excellent in themselves, but Sammy is having a hard time in keeping them. The spirit of Charley seems to stay with them.

Sammy is still awake to the necessity of system but he is very wide awake, too, to the need of introducing it in a proper manner. He is on the lookout for a good natured, broad minded, natural born and thoroughly trained diplomat to give the job to.

Charley now has a job where he has to deal with figures and not with men.

## Trade Opportunities in Mexico

By M. de Moreira

Of all the republics of Latin America Mexico is undoubtedly the most progressive, and on account of its geographical location the most easy of access to our manufacturers. The last statistics give the foreign trade of that republic as $240,690,000, out of which $116,681,000 went for imports. Of the total imports 62.7 per cent. came from America. United States, for once in Latin America, exports more than all the countries of Europe taken together.

Just now Mexico is all excitement over its petroleum industry. Native oil is placed on the Mexican market at a reduction of 20 per cent. in price and the Pearson company has just shipped to England 20,000 barrels of refined oil, thus showing clearly the development of the petroleum industry of the country. Recent government concessions cover the right to explore and exploit the petroleum wells existing in the southern part of the State of Vera Cruz, and in the adjoining districts of the State of Tamaulipas and San Luiz de Potosi. The concession granted to the Huasteca Petroleum Company has a capital invested of no less than $500,000. Another company has bound itself to pay annually into the Federal and State treasuries, respectively, 7 and 3 per cent. of the receipts obtained from such exploitation, so long as the output shall total 1,470,000 liters per day. This latter organization, known under the name of the Oil Fields Company, of Mexico, is to exploit the States of Vera Cruz and Puebla, and is to invest not less than $100,000. The flow of oil from the wells of the State of Vera Cruz have shown such a quantity and quality, that an English company has erected a large refining plant at Minatitlan, which is built along the most modern lines. The plant will be in operation within a short time. Illuminating, lubricating and fuel oils are to be manufactured. The company will erect 16 1000-barrel crude stills, 17 200-500-barrel lubricating oil stills, 17 200-barrel tar stills, five 1000-barrel steam stills, three 1000-barrel agitators, eight 500-barrel agitators, also storage tanks varying in capacity from 2 to 5000 barrels each. As that company also operates the Tehuantepec railroad, the latter's engines will be supplied with fuel oil. Formerly an oil company, which had its headquarters in St. Louis, Mo., had, for many years, the monopoly of the trade in Mexico. Now, however, the progressive works of these new companies have reduced the American works to insignificance.

### Steel Plate Production

Another work which gives American manufacturers a great opportunity, is the

establishment in Mexico of works for the production of galvanized, plain or corrugated, sheets and tinned sheets. A contract has been granted by the Mexican Government to a British contractor, who has agreed to invest $200,000 in the works and must manufacture annually 3000 tons of galvanized sheets and 2000 tons of tinned sheets. By the terms of the contract the contractor is allowed free entrance for machine tools, apparatus, electric-lighting material, etc. It seems that it would be to the advantage of the contractor to import tools and machinery manufactured in this country, as they compete advantageously with those of British make and have the advantage of costing less for freight.

### Railroad Extension

Railroads in Mexico, as in all South America, are a source of supply which our manufacturers should study seriously. The Pan-American railway has opened all over the different republics opportunities for repair and building shops, tools and machinery. The railroad extension from San Jeronimo on the Tehuantepec road to Tapachula, in Chiapas, has added another link to the great Pan-American system. The branch has an extent of 46 miles, forming part of the 305 miles now under operation on the Mexican territory. This line crosses fine coffee lands and the company naturally anticipates great profits in the transporting of the 40,000 tons of coffee beans, which is the average production of that district. The finest materials are used in the construction of this line; steel rails of 56 pounds were used for the first 125 miles and rails of 60 pounds for the rest. Steel bridges are also to be employed.

In the northern part of Mexico another railroad extension is also in progress, and the Rio Grande, Sierra Madre and Pacific will have soon its terminal in the timber district. The same company is extending the road from the timbered district at Medara and will continue until the two projections meet. Work will soon be started to bring this line to the coast. The result of this railway extension will be the development of the lumber industry, which until now has not been very progressive. A very extensive drying shed and sawmills having a capacity of 500,000 feet lumber per day are being constructed, also planing mills and turpentine sheds.

A railroad concession which was granted a few months ago will have a most important effect upon developing mining in the State of Guanajuato, where American investments sum up to $12,000,000. The representative of the Mexican Milling and Transportation Company has been authorized to construct and exploit for a term of 99 years a railroad between the municipalities of Guanajuato and La Luz. This railroad is to begin at Pepetapa, on the Mexican Central, and touch at various villages, plantations and mines. The new line is to be a regular network of rails, which will put into direct railroad communication with the Mexican Central and the United States all the prominent mines and mills of the State of Guanajuato.

On the southern side, contracts have been given which will give great facilities to Oaxaca and its mining section. On the west the construction of a railroad in the State of Sonora is also under construction. The entire line (100 miles) must be built in 18 months. The railroad will be a great advantage to the frontiers of the United States and Mexico, connecting important mining regions and putting the west coast in closer touch with the markets of the United States.

### Mining Machinery

Thus far the United States has held the market for mining machinery, but European countries are coming slowly to the front, as Mexicans, like other South Americans, complain very much of the slow delivery of American goods.

An important iron and steel manufacturing plant exists in the city of Monterey. The company has a capital of $10,000,000 Mexican. The output of that plant is mostly rails and structural products. Smaller iron works of more or less importance have their plants in Mexico City and in various parts of the republic. American manufacturers should remember that their machinery should find a ready market in those plants, and that a special trip to visit all these works, if made by a good salesman, should bear fruit.

### Sugar Machinery

American manufacturers do not seem to be very successful in placing sugar machinery. The British machinery is claimed to be heavier and stronger than the American and though the latter is 20 per cent. cheaper, the planter considers the difference in price of no account when breakdowns may mean a heavy loss; for though repairs can easily be done, still the crushing season may be over before the mill is again in operation. Another complaint made by sugar planters is that American manufacturers are not prompt in shipping. The importation of sugar machinery into Mexico increases every year, and it would be well for our manufacturers to make an effort to fulfil their promises as promptly as manufacturers of other countries, and thus not lose a trade which is a great source of revenue to Europe.

An example will demonstrate more forcibly the worth of my advice: A large importing house of machinery placed orders for sugar-making machinery with three firms in the United States. In each instance shipment had been promised as required. The machinery not arriving at the time agreed the house stood to lose $200,000 for non-completion of its contracts. It was necessary for them to send a representative to the United States to hurry the shipment. The expense for the trip and expenses in general in order to obtain these goods at a certain time amounted to $2000, which the importing firm had to lose. The moral of this is that from that time on that Mexican importing firm made all their contracts with British manufactories, who keep their promises, rather than with American, who fulfil them at their convenience.

The establishment of a packing house at Uruapam, with refrigerators, power turbines, cars, etc., has given to others the desire to start similar plants with the addition of a canning department. Surely American manufacturers will make the most of this opportunity.

### Opportunities in General

Briefly told, the opportunities for tools for railroad repair and building shops, power plants, mining machinery, iron piping, sawmills, planing mills, well drilling, structural steel, etc., form a substantial list from which the different manufacturers can cull what relates to their trade and thus increase the value of their export department. It is well to remember that Germans are waking up to the fact that Mexico needs other things besides dry goods, and the Hamburg houses are making every effort to supply at a lower rate the same kind of machinery as is manufactured in the United States.

Undoubtedly Mexico offers the greatest opportunities an American manufacturer can desire. He should not forget, however, that Latin and Saxon races are diametrically different in their customs, ways of living and business methods.

### Salesmen Must Adapt Themselves to the Country

The representative of an American house must remember that the Mexican's character is very susceptible, and that he naturally desires that foreigners wishing to do business in his country should conform to the customs of the country and speak its language. Catalogs and literature for Mexican circulation should be printed in Spanish; correspondence should be more detailed, less abrupt and terse than usually the rule here.

It is useless to speak of credits. Mexico is so near the United States that financial information can be obtained easily.

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One-half of all the cement manufactured in Canada is manufactured in the locality of Owen sound, the daily output there being 3000 barrels. The demand for concrete material for building the transcontinental railroad has increased the output to the full capacity of the plants during the year. During 1907, Canada produced 2,500,000 barrels of portland cement, and imported 1,000,000 barrels more, nearly all from the United States.

# Features of the "Ideal" Automatic Loom

## Surprising Results Obtained from Textile Machinery Building Methods in the Latest Development of The Stafford Company

## EDITORIAL CORRESPONDENCE

The person whose attention is fixed upon machine tools, or small tools, or precision work of any kind, is apt to lose sight of the value of methods used in building machines which are generally considered as outside of the precision class. The man who has been trained on machine parts that are finished all over, made to exact dimensions with perhaps limits of a fraction of a thousandth, and operated in connection with adjacent parts so that the clearance is only a few thousandths or at best a small fraction of an inch, is not apt to appreciate that complicated parts of automatic machines can be made almost entirely in the foundry. We frequently hear the criticism that such-and-such a machine is made too close; undoubtedly all of us have seen numerous examples where intelligent redesign eliminated finish on machine parts, simplified them, reduced their cost and made them approach the ideal condition of being used as received from the foundry, without in any way lessening the effectiveness of the mechanism in which the parts operated.

An example of machinery not made by precision methods, and one that will be suggested to the mind of every reader, is "textile machinery." Such expressions as "rough as a loom," "pickle fits" and "foundry made" are familiar to all who have had anything to do with the building of textile machines. While these quoted expressions contain elements of truth, we must appreciate the enormous extent of the textile machinery building industry, and must grant that the methods used produce machinery that function properly to the desired end. There seems to be a tendency in some quarters to make textile machinery better; that is, adopt within certain limits some of the precision methods of machine-tool builders. Yet we believe that more and wider reaching results for good can be obtained if the builders of precision machinery should study the underlying principles which enter into the successful production of machinery which is not made by such, so called precise methods.

In line with this belief we are pleased to present some of the interesting and essential features in the design, operation and manufacture of the latest development in automatic cotton-weaving looms.

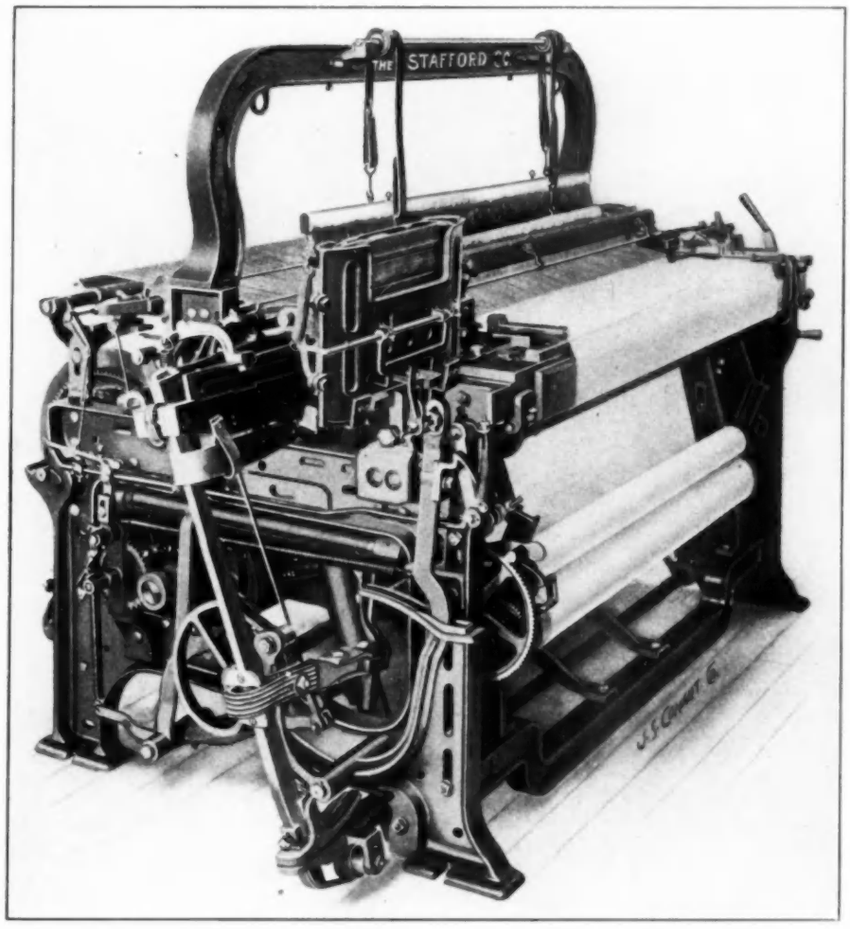



FIG. 1. THE "IDEAL" AUTOMATIC LOOM

### The "Ideal" Automatic Loom

The latest development in automatic cotton looms has been brought recently to a state of perfection by the Stafford Company, of Readville, Mass. It is known as the "Ideal" loom and is a machine that gives promise of having a great future. A completed loom carrying a warp and some finished cloth is shown by our half-tone illustration, Fig. 1. We do not purpose to describe the construction or operation of the loom in general, except as such description may be necessary in order to clearly present the automatic action.

The term "automatic" when applied to a loom is used to describe that class of looms which automatically feed a fresh supply of filling when the current supply is exhausted. In a plain loom, when the filling yarn runs out the loom stops. The weaver then takes out the spent shuttle, puts in one containing a bobbin of filling, pulls the shipper handle and the loom again begins to weave. The frequency with which a weaver has to perform this operation depends mainly upon the fineness of the yarn which he is using. Very coarse yarn runs off faster than very fine yarn. A bobbin that will hold 500 yards of 10's, will hold 2000 yards of 40's, in which case, if we assume that the 10's will run out in 2½ minutes, the bobbin full of 40's will last 10 minutes provided the speed and conditions of running are the same.

To a certain extent the number of plain looms to which one weaver can economically attend, is dependent on the counts of filling, although there are several elements which may produce a wide variation in a number estimated on this basis; as, the individual skill of the weaver, the nature of the goods, conditions in the mill, quality of the yarn, speed of the loom, etc. Under the very best conditions eight looms can be set safely as the limit-

ing number that can be attended by one weaver. To crowd looms on a weaver in excess of his capabilities means a loss of production per loom, and a certain deterioration in the quality of the goods. While eight looms have been set as the limiting number, there are comparatively few plain loom weavers running that number; six or seven are more usual, and on certain fancy goods a weaver is kept busy with one or two.

In mechanical terms, automatic is synonymous with labor saving. Both of these synonymous terms apply with equal truth to the "Ideal" loom; for a weaver can run from two to four times as many "Ideal" automatic looms as he can plain looms. In addition to this greatly increased production of finished goods the quality of the goods is improved.

### The Automatic Feature

The automatic feature is the same idea that is worked out in the automatic rifle. A reserve supply of ammunition is carried in the magazine of the automatic rifle; a reserve supply of filling is carried in the magazine of the "Ideal" automatic loom. A magazine is fastened to the breast beam of the loom in which is carried a reserve supply of shuttles, in number from 6 to 12 as conditions require. If a coarse yarn is running, a larger supply of shuttles is needed than if the yarn is very fine, for with the coarse yarn the shuttles change more frequently. When the filling becomes exhausted this fact is indicated by the filling fork in the usual way and the loom stops. This operation parallels the action of a plain loom under the same conditions. But in addition to this action the filling fork brings into play the shuttle-changing mechanism. The empty shuttle is ejected and a filled one is placed in the box and the loom restarts. The empty shuttle, when ejected, falls into a box provided to receive it. From time to time the weaver takes it from this box, inserts a fresh cop or bobbin, and replaces it in the magazine. The shuttles are usually of the hand-threading type and are threaded before they enter the magazine. A short length of yarn is drawn off and wound around the filling winder. Fig. 2 shows a magazine filled with bobbins and the box that receives the shuttles when they are ejected from the loom. Fig. 3 shows the operating mechanism on the magazine end of the loom, and Fig. 4 the mechanism on the other end.

Boys are employed to keep the magazines filled with shuttles; as a result the weaver can give his entire attention to the operation of weaving, and one weaver with one boy as helper can attend to from 26 to 30 looms. This is surely a large increase over the six or eight hand looms that constitute the maximum for one hand weaver. Another important and interesting feature which must be mentioned in this connection is the warp stop motion. The warp is, of course, the thread or yarn running lengthwise of the cloth. This yarn is wound on a large beam called the "warp beam," and passing over the whip roll it is drawn through the harnesses and reed and thence over the breast beam after weaving in the form of finished cloth. This cloth is drawn forward by the take-up roll and is wound on the cloth roll as fast as it is woven.

The number of ends or threads in a warp varies with the width of the goods and the fineness of the yarn; 2000 is a very ordinary number. If we assume that a weaver is operating eight plain looms of 2000 ends each he will have 16,000 ends under his charge. As the yarn is tender and the strain upon it considerable, there are bound to be a certain number of breakages. If we estimate these breakages at 10 per loom per day, in the course of a day's work the weaver will have 80 ends to piece up, or 8 ends per hour. While this piecing up is something of a task in itself, there is a burden of responsibility upon the weaver from the fact that he must be constantly alert to detect broken ends as they occur; otherwise they will show in the goods as defects and a deterioration in the value of the product will result. If a plain loom weaver has 16,000 ends under his charge, an automatic weaver, operating 30 machines under the same conditions, will have 60,000 ends to look after. This task would be very much beyond his capabilities.

Therefore, a mechanical device known as the warp stop motion is introduced which stops the loom as soon as a thread of the warp breaks. Fig. 5 shows the operating parts of this mechanism.

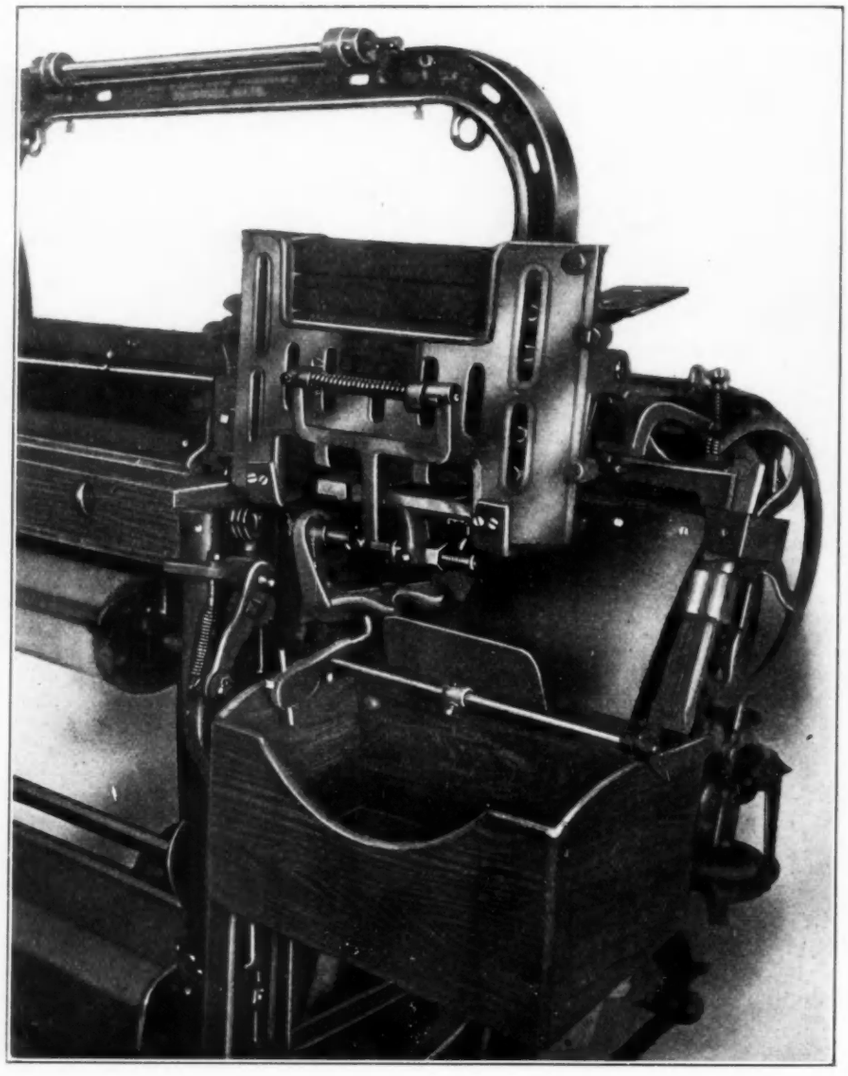


FIG. 2. THE SHUTTLE MAGAZINE

### The Automatic Mechanism

Engravings Figs. 6, 7 and 8, together with the half-tones Figs. 2, 3 and 4 explain the automatic mechanism and should be referred to while reading its description.

The five principal motions of a loom are (a) the let-off, (b) the harness motion, (c) the picking motion, (d) the beating-up motion and (e) the take-up

These motions will not be described in detail, but a few words are necessary in order to show the relation of each one to the other, and to the whole, in order to lead up to a clear understanding of the automatic mechanism.

The let-off is the means for controlling the warp and is arranged to let off positively a certain amount at each pick or to regulate the strains upon the warp during the process of weaving.

The harness motion raises and lowers the threads of the warp and so forms the shed or opening through which the shuttle is picked or passed. It is this interlacing of the yarn or filling left by the shuttle after it passes through the warp of the shed that forms the cloth. In making plain goods two harnesses are used; on fancy goods as many as 25 may be required. It is the harness motion that determines the pattern of the goods, or, in other words, the order in which the warp ends and filling interweave.

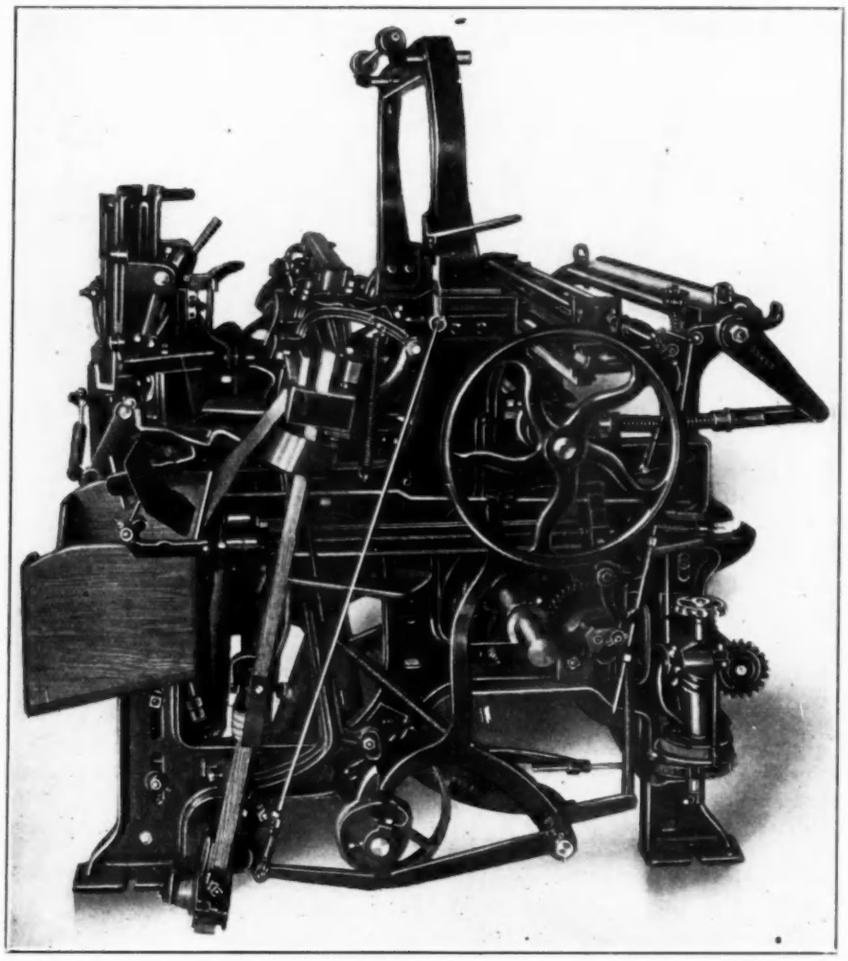


FIG. 3. THE MECHANISM OF THE MAGAZINE END OF THE LOOM

The picking motion is the mechanism that drives the shuttle across the lay and is one of the most important features of the loom.

The beating-up motion is the means by which the filling yarn is laid into the cloth. The lay, on which the shuttle travels, is supported by swords fulcrumed on rocker shafts at the bottom and toward the front of the loom, and receives a swinging motion from the crank-shaft to which it is connected by wooden pitmans. The driving pulley is located on the crank-shaft together with a gear that drives the bottom shaft. This bottom shaft carries the cams controlling the harness and picking motions, and is driven at one-half the speed of the crank-shaft. The crank-shaft rotates under from front to back of the loom and starts to pick the shuttle across when the shaft is on the top center. At this part of the cycle the harness cams have operated to separate the warp to permit the passage of the shuttle. This forms what is technically called the "shed." As the shuttle enters the shed the yarn is opened to its greatest extent and remains so for a brief space of time for the passage of the shuttle. The lay carries the reed which may be compared to a large comb with teeth of fine wire of a sufficient number to allow, in ordinary cases, two warp ends to pass through each tooth space. Before the shuttle has been boxed on the side of the loom toward which it has been picked the lay has commenced its forward movement. As it reaches the front center the reed engages with the filling left by the shuttle and forces this filling into the fell of the cloth. The lay now commences the return movement. The cycle of operations is repeated with the exception that the shuttle is now picked from the opposite end of the loom.

The take-up governs the number of picks per inch that enters the goods, and winds the cloth on a roll provided for that purpose, as fast as it is woven.

These five motions are found on every loom, although the details, of course, may vary. In addition to them there are certain common secondary motions such as a brake motion, shipper motion and filling motion. Of these secondary motions the first two require no explanation as the names suggest the functions that each one performs. The filling motion is the one that stops the loom when the filling yarn is exhausted or becomes broken. It will be referred to again in this article.

The two motions found on the "Ideal" automatic loom and not found on a plain loom are the shuttle-changing motion and the warp-stop motion. It will be noted that these are both secondary motions. They have no connection with the ordinary weaving function of the loom. In fact, in the case of the former, it is only called into action when the loom itself is stopped. At the moment it starts, the automatic motion is thrown off and remains idle until the filling fork indicates the absence of weft, then it is brought into action to replace the spent shuttle with a shuttle provided with filling.

In the line engraving, Fig. 6, *A* indicates the filling fork. The shuttle travels backward and forward across the lay leaving behind it a thread of filling. The lay beats up and the reed forces the filling into the fell of the cloth. As it feeds up the fork is normally prevented from passing through a grid or rack on the lay by the filling that extends from the selvage of the cloth to the shuttle. This gives a tilting motion to the fork and prevents it from engaging with the goose-neck $A^1$. However, when the filling runs out or breaks the fork passes through the grid and its hooked end engages with the goose-neck so that the filling fork and its holder, which are carried by a slide, are pushed forward, knocking off the shipper handle and allowing the pawl *B* to fall into the hook of the lever *B'*. This trips the automatic shuttle-replenishing mechanism and at the same instant throws on the brake and stops the loom.

In the line engravings, Figs. 6 and 7, *K* indicates a combination friction pulley and bevel gear; *I* indicates a shaft having a bevel pinion *J* on one end and a worm *H* on the other. The pinion *J* engages with the gear and the worm *H* with the worm wheel *G*. It follows that as the pulley *K* has a continuous motion the worm wheel *G* must also have a continuous motion, but at a comparatively slow

speed. This worm wheel is loose on the shaft *L* and carries no load until brought into use by means of the filling replenishing motion already referred to. This tripping is accomplished through the connections *C* and *E* and the clutch lever *F*, which is mounted on a hub keyed to the cross-shaft. This lever *F* is caused to engage with the disk cast integral with the worm wheel with the result that the cross-shaft is set in motion from the worm gear. Through the motion of cams on the opposite end of the shaft (see Fig. 8), the changing of the shuttles is accomplished.

The cams referred to are three in number; two of them are cast together as a single casting and the third is locked to the other two in such a way that it is impossible for them to get out of time. Turning to Fig. 8, *S* indicates the conveyer-lever cam and *W* the starting-lever cam which is cast integral with the front-board cam. The front-board cam is the edge cam shown in contact with the roll on the lever *N*. The operations controlled by these cams are as follows: As the cross-shaft revolves, the cam *F* starts the conveyer lever forward to receive a fresh shuttle from the magazine *T*. The cam *W* through the lever *N* and connector *O* now raises the front board *M* to permit the spent shuttle to be ejected by the continued action of this same lever *N*, which brings into operation the ejector *Q* and thus throws out the shuttle, to be guided by the leather apron $P^1$ into the receiving box $I^1$. The conveyer lever now starts back carrying a fresh shuttle. The front board is kept raised to permit of placing this shuttle in the box. After this is done, the front board is closed by means of the spring *P* and the conveyer lever starts toward its normal position. The starting-lever cam *W* now gives motion to the lever *X*. This motion continues through the shipper rod *Y* and the give-away lever *Z* throws in the shipper handle and starts the loom. By this time the conveyer lever has returned to its normal position and the clutch lever *F*, Figs. 6 and 7, coming in contact with the cam lever *E*, is thrown out and the cycle of operations is completed. The cross-shaft and all the parts and connections are now idle and remain so until it is necessary to replenish the filling again.

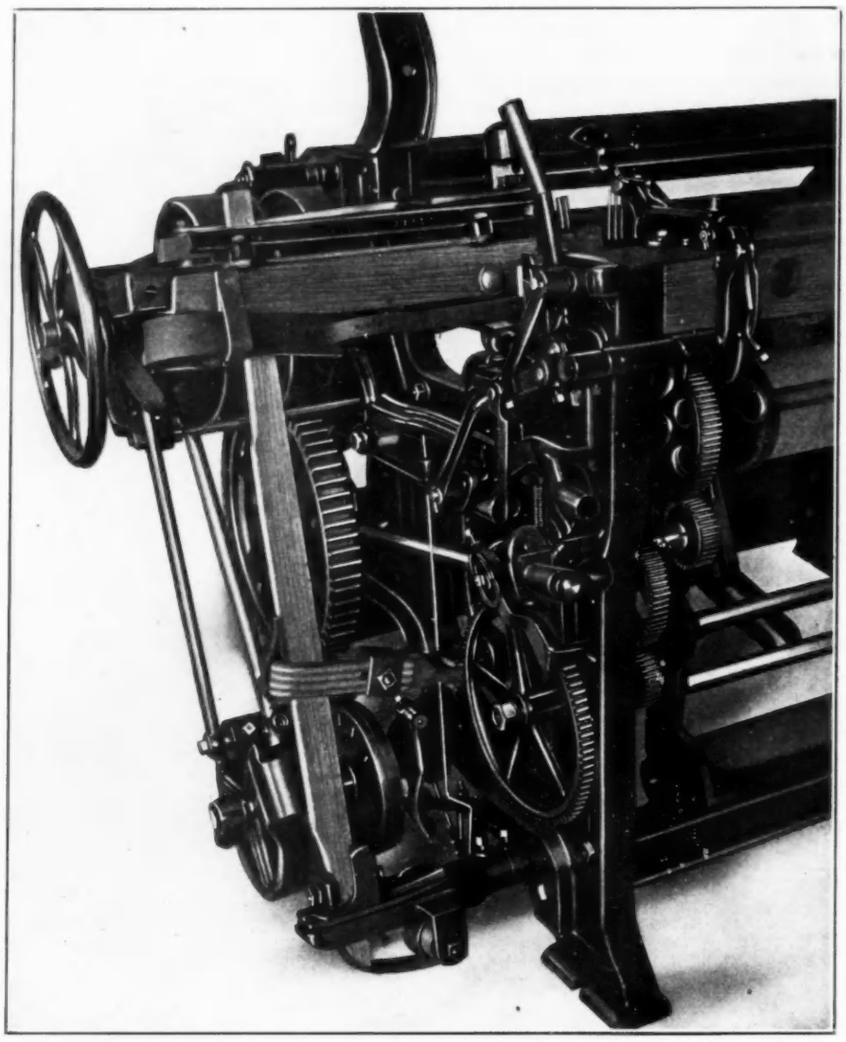


FIG. 4. THE MECHANISM OF THE DRIVING END OF THE LOOM

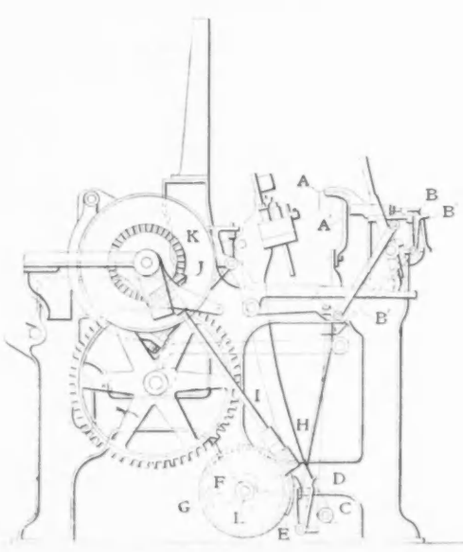



FIG. 6 THE AUTOMATIC MECHANISM—DRIVING END AND FRONT

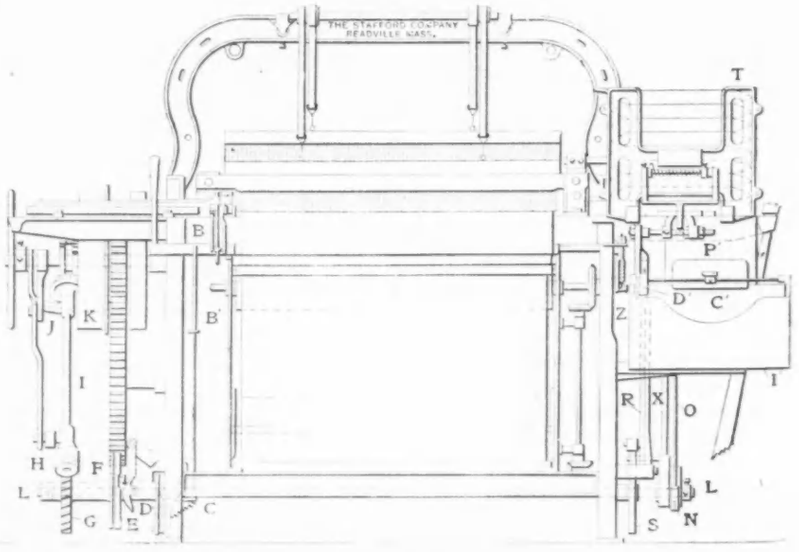



FIG. 7

To retrace our steps a little, we notice that as the spent shuttle is ejected and falls into the receiving box $I^1$ its fall is checked by the plate $C^1$, so that it falls easily and without shock into the box and thus is prevented from receiving undue wear. The plate $C^1$, however, has a double function. In addition to checking the fall of the ejected shuttle, it prevents the possibility of there being two shuttles in the loom at once. Were it not for this device such a situation might develop through accident, or through some fault of the weaver. The plate $C^1$ acts in connection with the weighted lever $D^1$ and the hook $E^1$. Normally, as the conveyer lever goes forward to receive a new shuttle, the hook engages with a recess which can be seen in the conveyer lever $R$. This hook is released when the spent shuttle

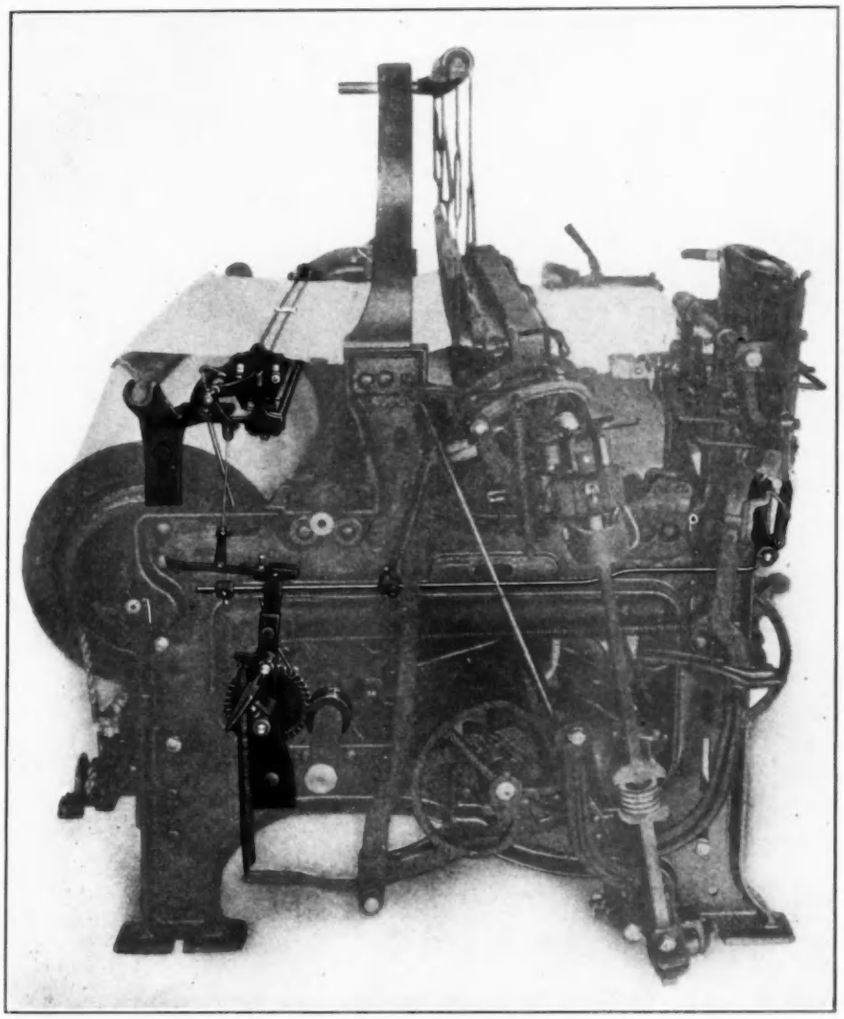


FIG. 5. THE WARP-STOP MECHANISM

falls on the plate on its way into the receiver box and thus frees the conveyer lever so that it can perform the rest of its normal function; but if no shuttle is ejected the hook remains engaged with the conveyer lever, so that the lever is held away from its cam. The cam thus completes its rotation without giving the normal motion to the conveyer lever, thus no new shuttle is placed in the loom and the loom will not start.

Another safety device guards the motion that operates the cross-shaft at $D$, Fig. 6. This device renders it impossible for the worm wheel to give motion to the cross-shaft unless it is thrown into engagement in a normal way through the filling fork.

The warp-stop motion that has been referred to is driven by the gear $G^1$, Fig. 8, on the bottom shaft; this gear drives the gear $H^1$, on which is a cam that gives a reciprocating motion to the lever $L^1$. The follower bar $M^1$ is driven by $N^1$, and receives motion from the connecting-rod $O^1$ and a crank and swivel on the driven gear-shaft. As the follower bar travels backward and forward it causes the hook $J^1$, by means of a wire connector, to clear the give-away collar $F^1$ on the rod $Y$. If however, the motion of the follower bar is arrested by a fallen drop wire $K^1$, of which there is one for each warp end, the hook is not lifted, but engages with the give-away collar $F^1$ on its next movement. Then as it goes forward it carries the rod $Y$ with it. This rod knocks off the shipper handle and stops the loom.

### THE MOTIONS AND PARTS OF THE MECHANISM

We have described at some length the mechanism and operation that control the replenishing of the filling. These operations consist in stopping the loom if the

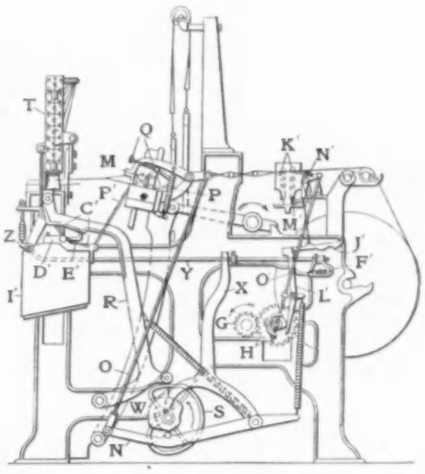



FIG. 8. AUTOMATIC MECHANISM—MAGAZINE END

filling is exhausted or broken, removing the spent shuttle, inserting a fresh shuttle, and starting the loom, together with several safety devices that prevent any succeeding operation from being carried out until the preceding operation has been successfully completed. The operation of all of this automatic mechanism is dependent upon a fine thread or yarn that may measure only 0.002 or 0.003 inch in diameter and have almost no tensile strength. If this small, fine, weak thread of filling crosses a certain point at a certain moment of the cycle of operations of the loom, the loom continues to weave without change in its operation. If, however, this small, fine, weak thread of filling is not at a particular point at this particular moment of the operation of weaving, the entire series of automatic motions are brought into play, and after having been successfully completed the loom is again weaving as it did before the mechanism took notice of the absence of the thread of filling.

That this mechanism is not by any means slow in its operation can be realized from the statement that on some classes of goods the narrower looms run at a speed of 200 picks per minute.

It is interesting to note the character of the individual parts that enter into this automatic mechanism. As they do not differ from loom parts in general we can broaden our statement to cover the entire loom. There is not one finished cam in the entire loom. There is not a single cut gear. Every ratchet has cast teeth and some are as fine as 160 teeth on a circumference 9¼ inches in diameter. All of the worm wheels are cast; there is only one cut worm. There are only two machined shafts; one is the crank-shaft that is ma-

chined on the wrist pins and ends, the other is a plain shaft that is machined only on the ends. There is very little turning, aside from a few rolls, hubs and the like. In connection with drilling we should point out that all holes which are to finish ½ inch in diameter or larger are cored.

Fig. 9 shows a representative lot of parts from the automatic mechanism. This lot covers a wide range. There are cams, spur gears, bevel gears, worm gears, pulleys, brackets, levers, and the like.

A consideration of these results and the methods of manufacture of the parts entering into the mechanism justify our statement, that the makers of certain lines of so-called precision machinery can do well to study the underlying principles entering into the manufacture of textile machines.

### Foundry Work

As would be expected from the statements in the foregoing section, the foundry work on the parts entering into this automatic mechanism is of the best. Molding machines are extensively used and the gating of small patterns is common.

Fig. 10 shows a lot of representative small patterns in gates of from 2 to 12. As a great deal of the mechanism on the ends of a loom is the same with the exception of a difference in hand, many parts have to be made both right- and left-handed. In the upper central part of Fig. 10 four sets of patterns may be seen;

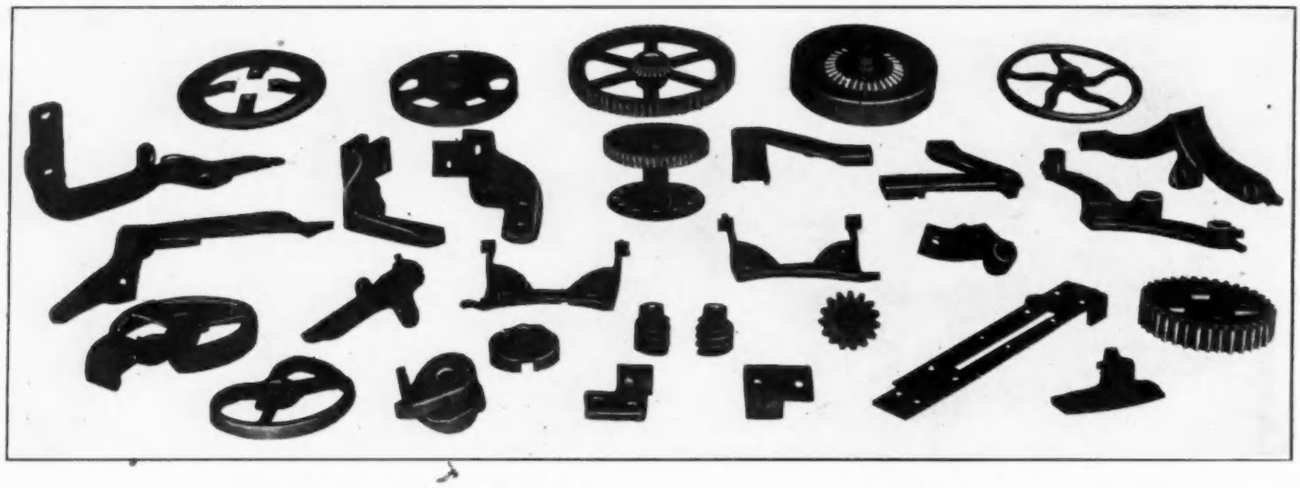


FIG. 9. A REPRESENTATIVE GROUP OF PARTS FROM THE AUTOMATIC MECHANISM

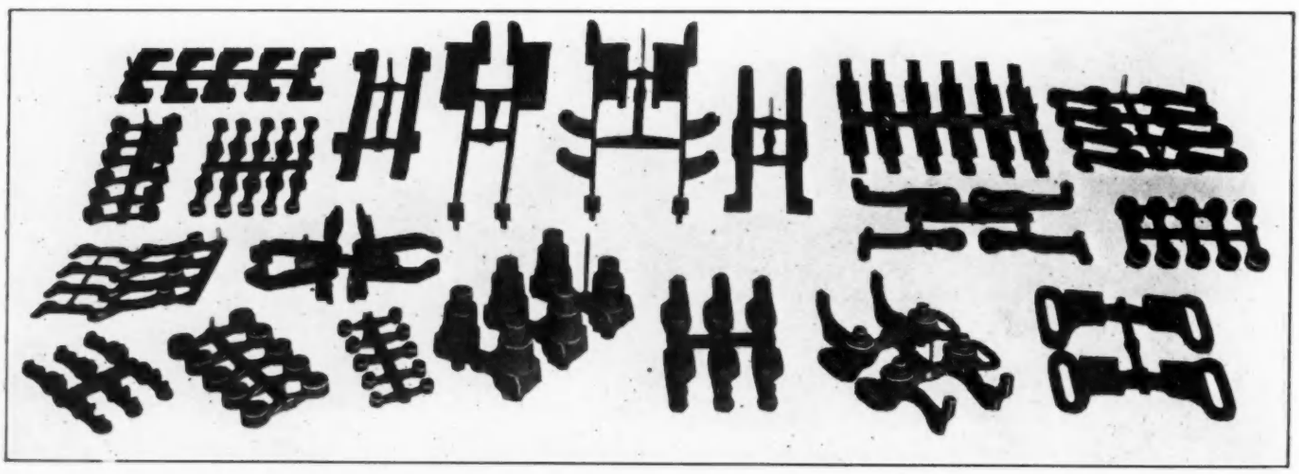


FIG. 10. A REPRESENTATIVE GROUP OF GATED PATTERNS

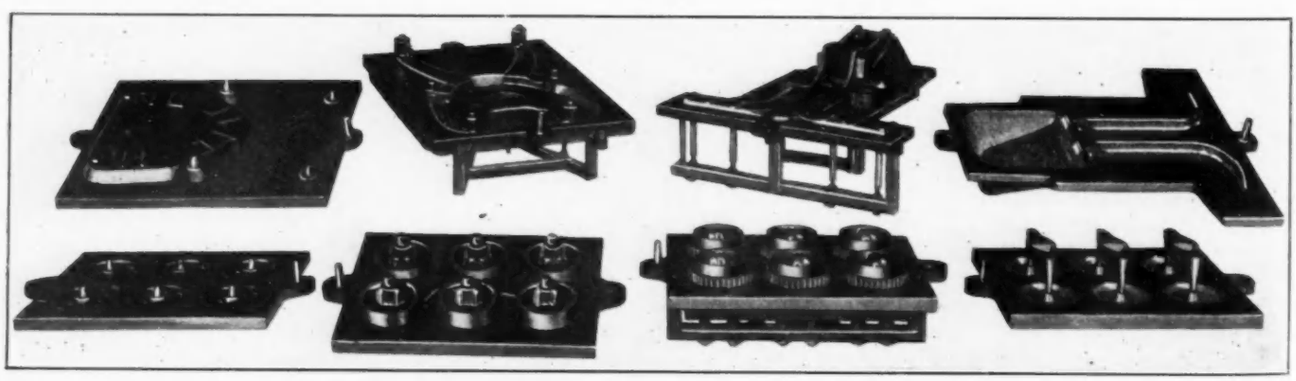


FIG. 11. A REPRESENTATIVE GROUP OF MOLDING MACHINE PATTERN PLATES

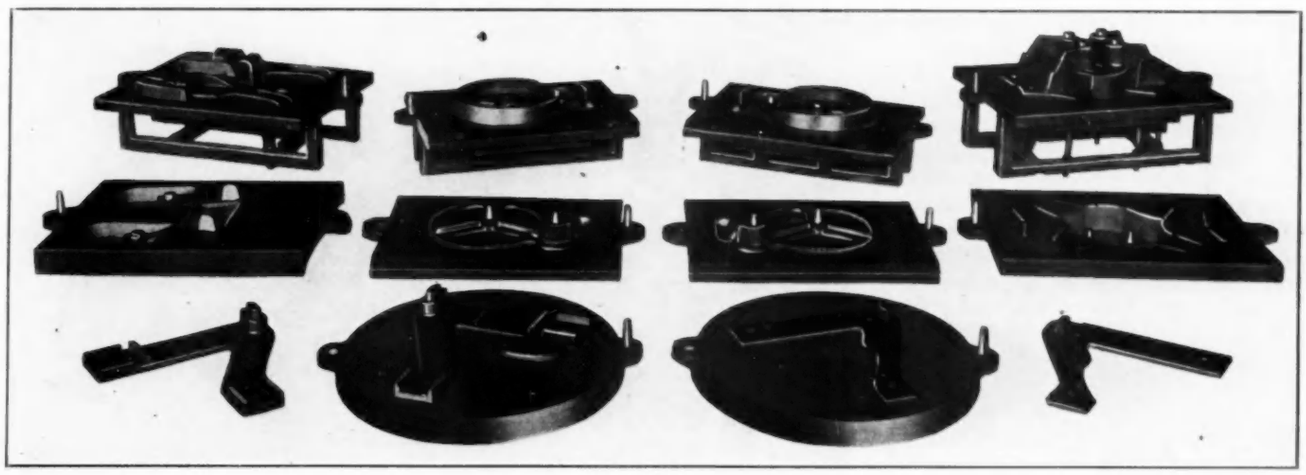


FIG. 12. ANOTHER GROUP OF PATTERN PLATES

each set consists of a right-hand and a left-hand pattern gated together. Wherever possible, holes are made to core themselves. For illustration, see the middle gate at the extreme right of Fig. 10. In case the hole is too small to core itself, or too small to be cored by a baked core, spotting is resorted to in order to afford an easy means of starting the drill in the machining operation. The third gate from the left-hand end in the lower row of Fig. 10 illustrates this point. No claim is made that these points in connection with gating patterns are restricted to the textile-machinery business, but they are pointed out to show the trend of the detailed thought and care that enter into the pattern-making and molding methods.

Figs. 11 and 12 show a series of pattern plates for molding machines. No special comment is needed other than to call attention to the excellence of the work. By such means castings are produced, first, accurately, and second, cheaply.

### Some Jigs and Fixtures

Fig. 13 shows a representative group of drilling jigs, selected from the parts forming the automatic mechanism. The large one in the upper central part of the half-tone is for the combination cams that operate the starting lever and front-board lever. The methods of bringing the cam to a stop and of holding it are plainly shown. The jig in the upper right-hand corner has an interesting cam device for locking the casting in position. In the lower part of the half-tone are shown two tongs jigs that are very rapid in manipulation. The small jigs directly in front of the large cam jig are used for a piece that is spotted for drilling from a pattern.

Fig. 14 shows a group of milling fixtures. There are several points in connection with them that are well worthy of notice. The long fixture in the upper right-hand corner is arranged to mill both right- and left-hand pieces at the same time. These pieces are ganged in the fixture, as shown. The next fixture to the left takes a long gang of pieces that are alike. The next two fixtures to the left each take a left- and right-hand piece at the same setting. These three principles, first, the ganging of pieces in a fixture; second, the ganging of right- and left-hand pieces in the same fixture, and third, the setting of a right- and left-hand piece in the same fixture at the same time, are carried out to a great extent and with excellent results.

### Ganging Operations on Machine Tools

Fig. 15 shows a further continuation of the ganging idea, as carried out on a large horizontal milling machine. Two fixtures are provided; each has two grooves to hold the castings that are to be milled. The arbor carries eight slotting cutters, or two cutters for each one of the fixture grooves.

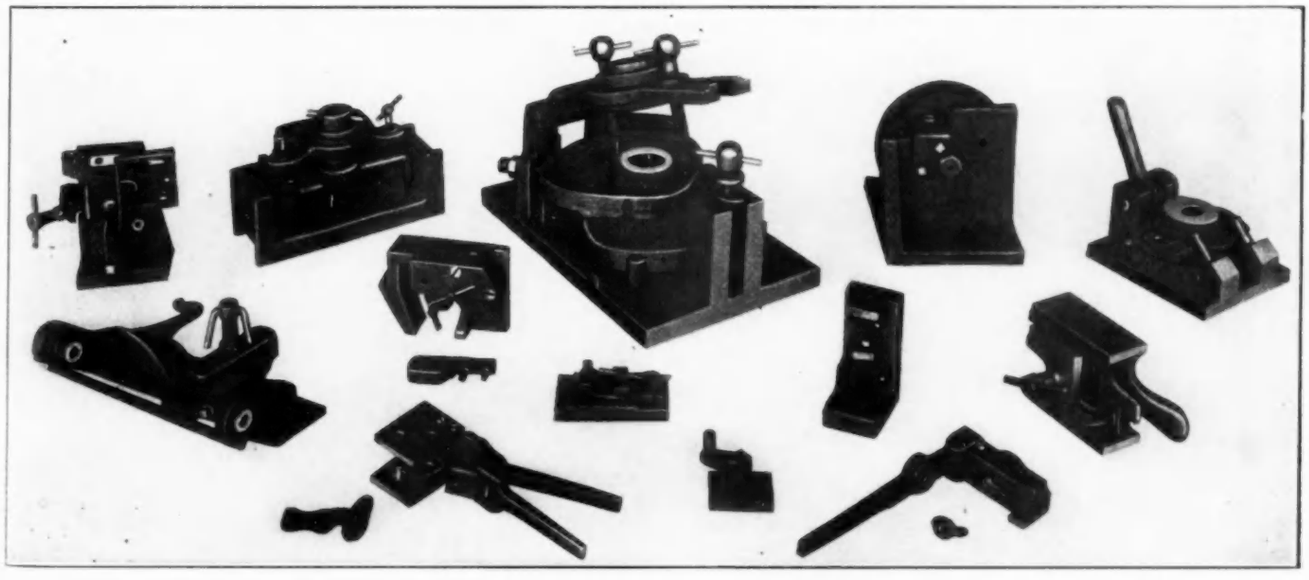


FIG. 11. A REPRESENTATIVE GROUP OF MOLDING-MACHINE PATTERN PLATES

### Special Machines

Figs. 16, 17 and 18 show machines used for making loom crank-shafts.

Fig. 16 shows a large, power-driven, bending press used for forging the cranks of the crank-shafts. The shafts are forged from round bars. The bar is gripped in jaws that are mechanically forced toward each other during the same interval that a plunger is forming the bend.

Figs. 17 and 18 show a special crank-pin turning machine. The cutting tools are in the form of sectional hollow mills carried in suitable holders, that are driven by an eccentric of the same throw as the eccentricity of the crank. The machine has three of these holders and is thus capable of turning at one time the pins of a crank-shaft having three cranks.

The development of special machines for special operations, as illustrated by these two machines for making crank-shafts, is another noteworthy feature of textile-machinery building. This is one of the features that contributes to the well-merited success that American textile builders have achieved.

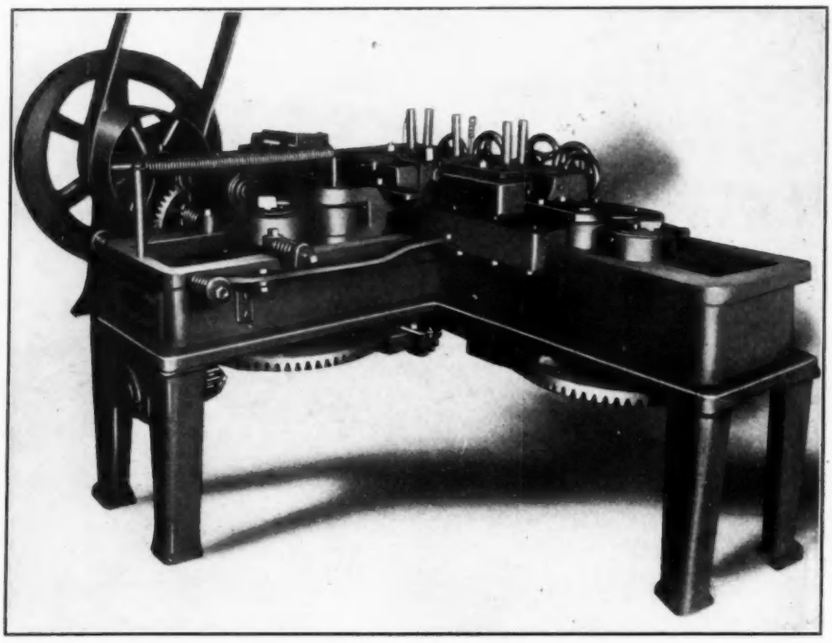


FIG. 16. A CRANK-SHAFT FORGING PRESS

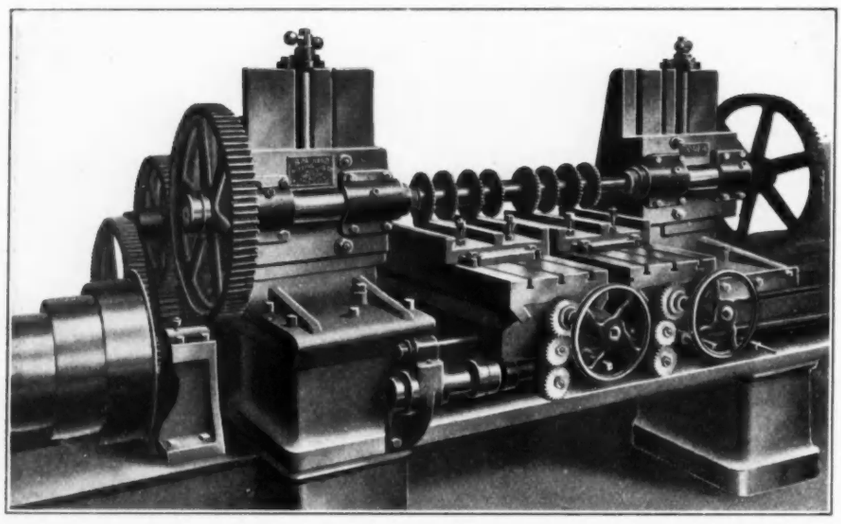


FIG. 15. A SET-UP FOR GANG MILLING

Behind all of this mechanism and these manufacturing operations stands the designer. Designing such machine parts calls for a different application of mechanical knowledge and skill than is exercised in the design of the average precision machine. Finish is eliminated. The designer cannot call for finish at a particular place, and leave to the patternmaker the precise amount of finish that shall be added, with the knowledge that if it is too much the machinist can easily remove it in the machining operation. The general dimensions of parts must be established by the designer, instead of being treated as patternmakers' dimensions to be finally worked out in the pattern shop. The clearances must be established between various members, so that they will properly exist between parts that are used as

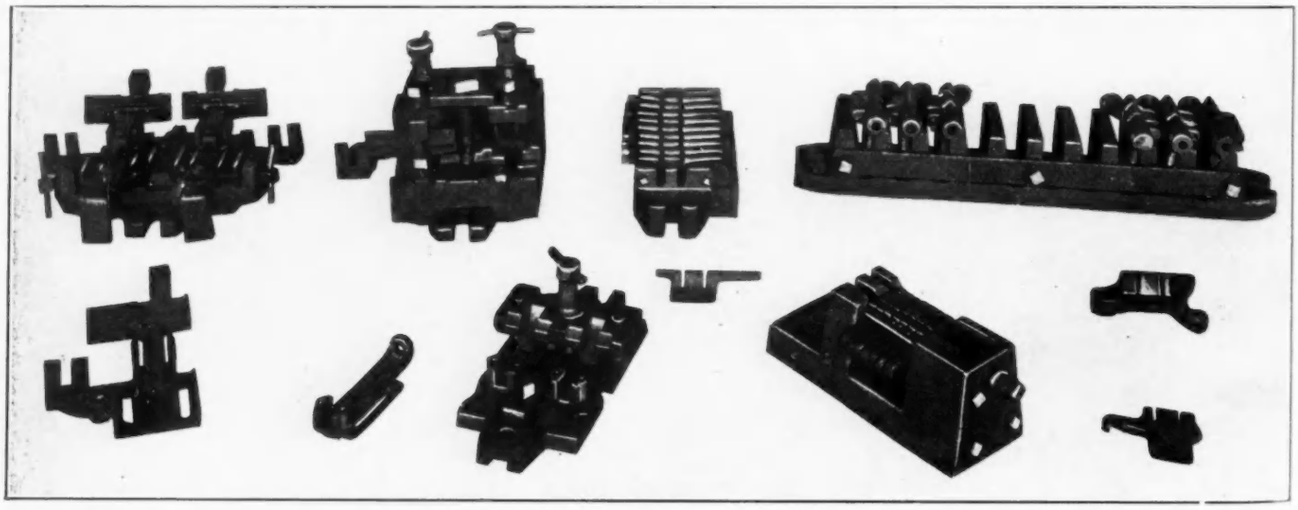


FIG. 14. A REPRESENTATIVE GROUP OF MILLING FIXTURES

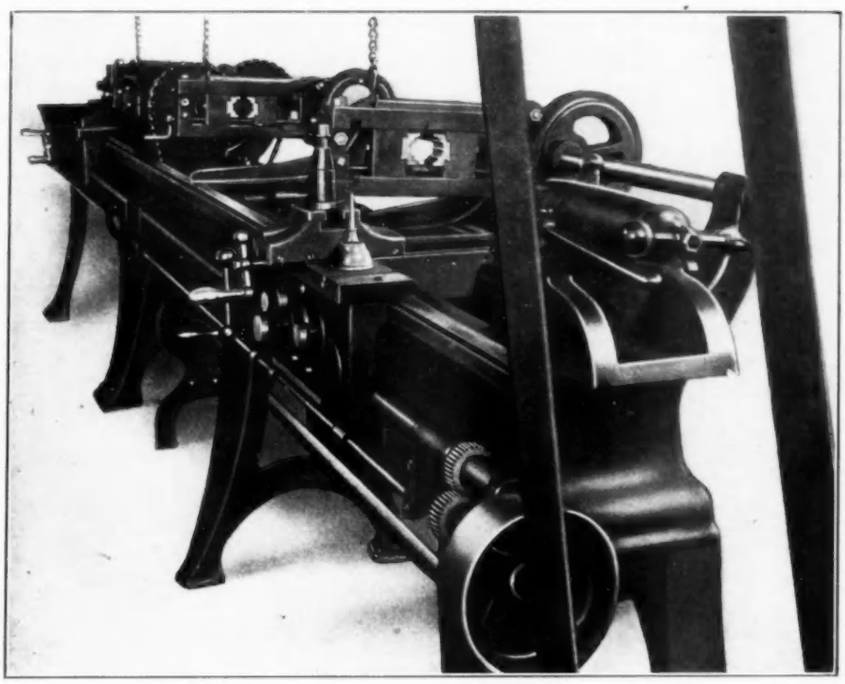


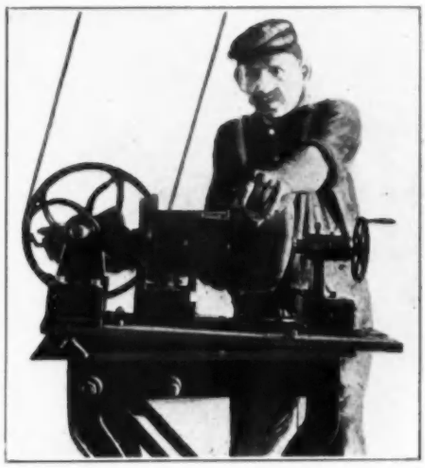
FIG. 17. CRANK-SHAFT TURNING MACHINE SHOWING THE HOLLOW MILLS

they are received from the foundry. Patterns must be so made that the effect of excessive shrinkage or rapping will have as little effect as possible at the working or vital points of the castings. Jigs and fixtures must be so designed that the stop will bear against a point on the casting which is either vital as regards the operation of the parts, or else is subject to very little variations between different individual castings. Adjustments must be provided to care for certain variations that will occur, and to properly time the various parts of the mechanism. In connection with all of these elements runs the all-important fact that the parts must be made cheaply, for looms and textile machines, in general, are sold at a comparatively low price per pound.

It is a pleasure to acknowledge the uniform courtesy and assistance of The Stafford Company in providing the photographs, drawings and data that have entered into this article.

## Grinding in Gas-engine Pistons

The Acme Motor Car Company, of Reading, Penn., has an interesting little device for grinding in piston rings. The piston is mounted on a connecting-rod and a single throw crank-shaft driven by a belt, gives a reciprocating motion to the piston. The cylinder is perfectly free on the piston and is turned by the operator at the same time the piston



GRINDING IN PISTON RINGS

is moved back and forth in the cylinder. This is done with every cylinder, and the particular piston fitted with its ring remains with that cylinder. This gives an excellent surface on the cylinders and rings and the makers claim that it gives a perfect running cylinder from the time it is assembled.

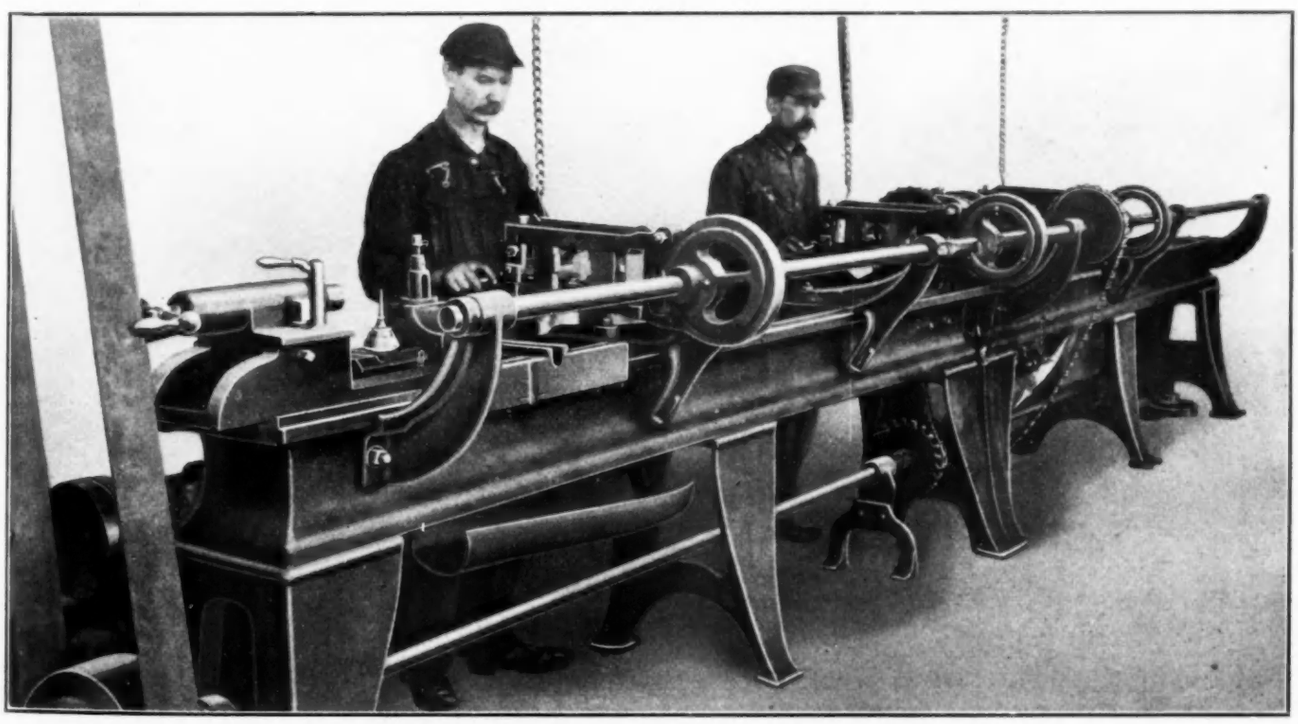


FIG. 18. THE CRANK-SHAFT TURNING MACHINE IN USE

# Notes on the Behavior of Beams

## Often Results of Tests Do Not Apparently Agree with Theory—Increase in the Stresses Carried by Intermediate Fibers an Explanation

BY E. H. FISH

Whenever one breaks a piece crosswise, as a beam in a testing machine, and then attempts to make the results of his test and the beam theory agree, he is apt to receive a jolt that makes him wonder why. This is more pronounced in the case of cast iron, mainly because of the ease with which cast iron may be broken. As for soft steel, it is impossible to break it in any ordinary testing machine; the bed of the machine stops the downward deflection of the specimen long before it has reached the breaking point. With cast iron, on the other hand, a very slight, almost unnoticeable deflection is accompanied by fracture. Curiously, the pressure necessary to produce fracture is often double, sometimes more than double, that which would be expected from the use of the ordinary beam theory and the tensile strength of the cast iron.

I have in mind some experiments on 1-inch square bars of cast iron, supported 12 inches apart and loaded at the middle, when a load of something like 2600 pounds, average, was required to break them. This same cast iron tested in tension carried only 21,000 pounds, and in compression from 120,000 to 140,000 pounds per square inch.

The beam formula familiar to all readers is:

$$M = \frac{p\,I}{e},$$

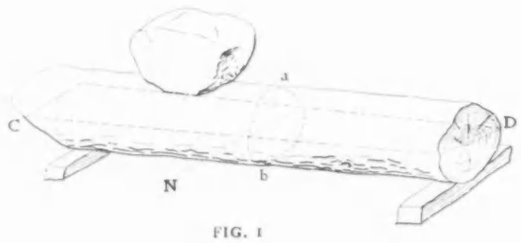



FIG. 1

FIG. 2

DIAGRAMS ILLUSTRATING THEORY OF BEAM FLEXURE

where $M$ is the bending moment in inch-pounds, $p$ the tension or compression on the most strained fiber, $I$ the moment of inertia of the cross-section, and $e$ the distance from the center of gravity of the cross-section to the most strained fiber. This last expression, $\frac{p\,I}{e}$, is sometimes called the "internal bending moment," though it would be better to call it the "internal straightening moment." The moment $M$ for a beam loaded at the middle in $\frac{W\,l}{4}$, where $W$ is the load in pounds and $l$ the length in inches. For a square section $\frac{I}{e}$ is $\frac{h^3}{6}$, where $h$ is the side of the square.

Then

$$\frac{W\,l}{4} = p\,\frac{I}{e}$$

becomes

$$\frac{W\,12}{4} = 21{,}000 \times \tfrac{1}{6}$$

and $W = 1166$ pounds.

This is only about one-half of what it really held. If we use for $p$ 120,000 pounds, the lowest breaking strength of the material in compression, then we get for $W$ 6666 pounds, or more than double its actual strength.

### Derivation of the Formula

Now let us see how the beam formula is derived. First we let Fig. 1 represent a log of any cross-section resting on supports at its ends and carrying a load anywhere. Let $a\,b$ represent an imaginary section square across the log at any point in its length. There will of necessity be some horizontal plane through the log where the fibers will be neither stretched nor compressed, since our common sense tells us that the top fibers are compressed and the bottom ones stretched. Let this plane be represented by $c\,d$ and call it the neutral plane. Let its intersection with the section $a\,b$, at $N$, be called the neutral axis of the section.

The first assumption in the beam theory is that all tensions and all compressions of fibers below and above the neutral axis are proportional to their distance from that neutral axis and are zero on that axis. This is more clearly shown in Fig. 2, which represents a view of the log near the joint where the section $a\,b$ is taken. The arrows represent the forces which act on the right-hand side of the section to hold it in place. It will be noted that if there are no outside forces acting on the beam except vertical forces, the sum of all these internal forces acting toward the right must be equal to the sum of all those acting toward the left. The second assumption in the beam theory is

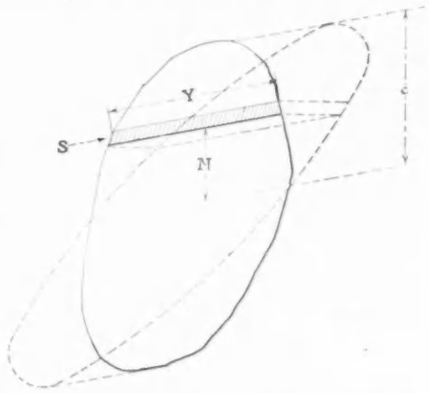



FIG. 3. DIAGRAM TO ILLUSTRATE THEORY OF BEAM FLEXURE

that the modulus of elasticity is the same in tension as in compression. This means that if the pressure on the top fiber is $p$, as marked in Fig. 2, the tension in the lower fiber will be $p$ also, provided the neutral axis is in the middle of the depth. If it is not, then the tension on that lower fiber or on any other fiber is proportional to its distance from the neutral axis. This gives us a basis for finding the position of the neutral axis.

Referring to Fig. 3, which is an enlarged view of part of Fig. 1, let the strip of surface of the section marked $s$ be $y$ inches wide and $d\,z$ inches high. (For the benefit of those not familiar with calculus, I will say that $d\,z$, or differential $z$, is simply a small part of $z$, having the same functions; just as a few drillings out of one pig of a carload give the chemist an analysis for the whole carload.) Let this strip be taken at a hight $z$ from the neutral axis, the position of which is as yet unknown. Then the pressure per square inch on this strip $s$ is $\frac{z}{e} \times p$, where $p$ is the pressure on the top fiber and $e$ is the, as yet, unknown distance from the neutral axis to the top of the log. The pressure over the whole area of the strip $s$ is then, $(y\,d\,z)\left(\frac{z\,p}{e}\right)$. The pressure over the whole area from top to bottom is, $\int \frac{p}{e}\,y\,z\,d\,z$ (which

is simply another way of saying that we must add up all the pressures on all the horizontal strips corresponding to $s$).

We have already decided that all the compressions above and all the tensions below the neutral axis must balance each other, hence their algebraic sum must equal zero. If $\int \frac{p}{e} y\, z\, d\, z = 0$ then, since $\frac{p}{e}$ is a constant, $\int y\, z\, d\, z = 0$. But that condition is possible only when the neutral axis passes through the center of gravity of the cross-section; because $(z)\ y\, d\, z$ is the moment of the strip $s$ or any other similar strip about the neutral axis. If the moments of all these strips are equal to zero then the moments must have been taken about an axis through the center of gravity of the sections. Remember that this is true only when the modulus of elasticity of the material is constant. Now to find the tendency of these pressures on all these infinitesimal strips to resist the external bending moment, that is, to find the internal bending moment, the pressure on this individual strip is $z\ y\ d\ z\ \frac{p}{e}$; its moment around the neutral axis is $z^2\ y\ d\ z\ \frac{p}{e}$, or the pressure multiplied by the distance $z$ to the neutral axis. If we sum up all these and reunite we have $\frac{p}{e} \int (y\ d\ z)\ z^2$, (where $d\,F$ is an infinitesimal area) is called the moment of inertia of the section. The symbol $I$ is almost universally used for this moment of inertia, so the sum of all the internal moments may be written $M = \frac{p\ I}{e}$ which is the common form of the equation.

by means of calculus we have:

$$M = \left[ \frac{p\ b}{-\frac{h}{2}} \frac{z^3}{3} \right]^{\frac{h}{2}}_{\frac{h}{2}}, \text{ or } M =$$

$$\frac{2\ p\ b}{3\ h} \left( \frac{h^3}{8} + \frac{h^3}{8} \right) = \frac{2\ p\ b\ h^4}{12\ h} = \frac{p\ b\ h^2}{6}.$$

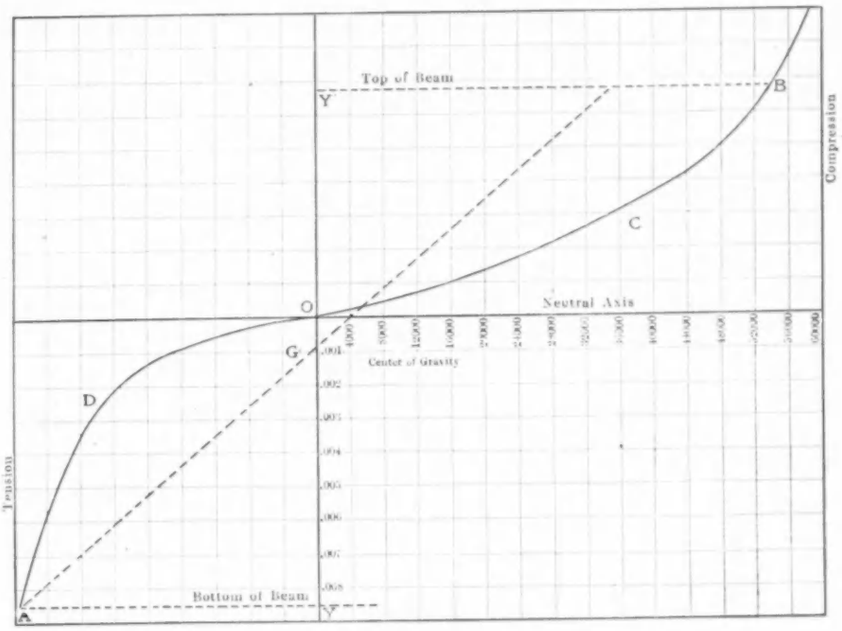



FIG. 5. STRESS-STRAIN DIAGRAM OF A SPECIMEN OF GUN IRON

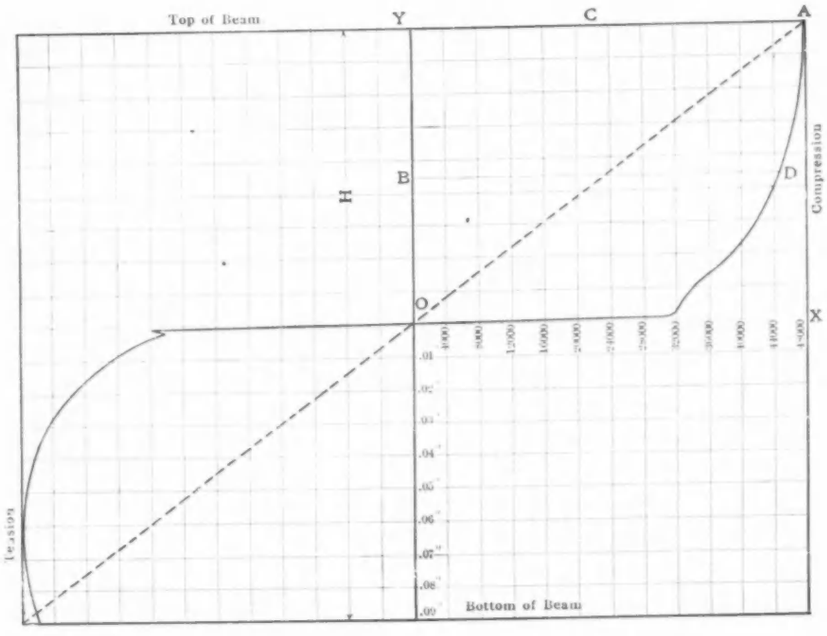



FIG. 4. STRESS-STRAIN DIAGRAM OF A STRUCTURAL-STEEL BEAM

in which $\frac{p}{e}$ is constant.

The expression $\int y\, d\, z$ is the area of the surface and $z$ is the distance of each strip from the neutral axis. Now

$$\int y\, d\, z\, z^2 \text{ or } \int d\, F\, z^2$$

For a rectangular beam of hight $h$ and breadth $b$ this formula becomes

$$M = \int \frac{p}{e}\, b\, z^2\, d\, z$$

between the limits of $\frac{h}{2}$ below the neutral axis and $\frac{h}{2}$ above. Integrating

But to get at this result it has been assumed that the various fiber stresses from the center out to the top and bottom varied proportionately to their distances from the neutral axis.

### Comparison of Actual Results and Theory

Fig. 4 represents, plotted to the scale, the actual results of experiments in tension and compression on a piece of structural steel; horizontal distances from $O$ represent tensions to the left and compressions to the right in pounds per square inch; distances up and down represent stretches and compressions in inches. Now it will be seen that when $p$ is less than about 30,000 pounds the pressure varies directly as the stretch. Above that point the variation is considerable. In order to break this beam, or to give it any considerable bend, it is necessary to give it considerably more load than would cause a fiber stress of 30,000 pounds. In testing we might easily give it a pressure which would produce a fiber stress of 48,000 pounds, for $p$ in our formula, but if we apply the formula as written we only get for a result a load which would be correct if the pressure on the fibers of the material varied according to the direct proportion mentioned above and represented by the straight line $A\ O$.

It will be seen readily that if the outer fiber of our beam is stressed up to $p$

pounds, the fiber half way to the center, or at neutral axis, will be stressed, not to ½ $p$, but to 45,000 pounds as indicated at $B\,D$, which may be nearly or quite up to $p$, according to the shape of the stress-strain diagram for any particular steel. From this it will be seen that the fibers some little distance in from the top and bottom

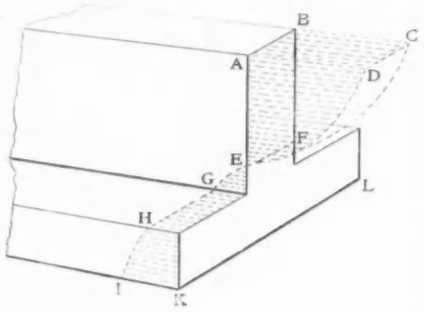



FIG. 6. GRAPHIC REPRESENTATION OF THE DISTRIBUTION OF PRESSURE OVER A T-BAR

of the beam may be doing duty nearly up to the maximum fiber stress $p$; consequently the beam in a way may be said to be more efficient, in that it is carrying a load which the ordinary formula tells us ought to break it. Suppose that we apply this curve to our beam, or rather apply a beam to this curve, since that is more easily done. It is only necessary to draw a line through $A$ and one as much below $O$ as $A$ is above it for the top and bottom lines of the beam. If we compare the $H$ for this beam with the $h$ of Fig. 2 we have the scale of Fig. 4 as applied to a beam. As before, pressures to the right, compressions, must be equaled by pressures to the left, tensions.

Since measurements in a horizontal line from $O\,Y$ represent pressures, the total pressure to the right is proportional to the *area* $Y\,A\,D\,O$ and the same is true of the corresponding area below $O$. If the beam is rectangular in cross-section and if, as in this case, the two areas are practically equal, then the neutral axis passes through $O$ or the center of gravity of the section. If, as in a case which we will look at later, these two areas are not the same, then we would have to shift the bottom of the beam until the two areas were equal. In this case then we will have for the moment of the internal forces, not the sum of the moments of forces varying from $O$ to $A$ according to the straight line, but according to the curved line $O\,D\,A$. To find the sum of all the moments we simply have to take the area $Y\,A\,D\,O$ and multiply it by the distance to its center of gravity or, what is easier in this case, take the area of every strip between the heavy cross-section lines and multiply it by the distance of its center from the line $O\,X$.

Then add as much more for the moment of the tension forces. In this particular case the sum of all these moments is 1.43 times as great as would be given by the ordinary formula, which agrees passably well with experiment.

### Diagram for a Cast-iron Specimen

Fig. 5 represents a diagram similar to Fig. 4, but for a specimen of cast iron instead of steel. In this case we have taken $Y\,A$ at the breaking tension of the cast iron and left $O$ in its original position, and placed the top of the beam enough above $O$ so that the area $Y'\,B\,C\,O$ is equal to the area $O\,Y\,A\,D$. The ratio $O\,Y'$ to $O\,Y$ gives the relative position of the neutral axis from the top of any *rectangular* beam only. It will be seen that the apparent strength of the beam has been increased over that given by the usual formula and based on the fiber stresses indicated by $A\,O$ by the curving of the line $D$, by the raising of point $O$ and by increasing $Y'\,B$, the greatest compressive stress, and without nearly reaching the breaking strength of the compression side of the beam.

It will be noticed that in this beam the neutral axis through $O$ has not been shifted through a great distance, but the movement of the internal stresses about $O$ is very evidently greater than it would have been about $G$ (the center of depth or center of gravity of the cross-section), if the same maximum fiber stress $A\,Y$ had been reached, but the material had been of such a nature that the fiber stresses had followed the straight line as indicated by the dotted line $A\,G\,B$. Careful scaling and figuring show the increased movement of these internal forces to be 164 to 100 for the straight line. The increase is more marked with irons which show a lower tensile strength.

The specimen from which the curve of Fig. 5 is plotted was a piece of gun iron tested at Watertown, and is exceptionally tough, breaking only under a tension of 35,000 pounds. The ordinary run of machinery iron may be expected to go only a little, if any, above 20,000 pounds. With such iron, having a curve on the compression side about the same as the one shown, a difference of 200 or 240 to 100 is not uncommon.

In this connection a rather curious thing is to be noted. On the basis of this iron carrying 1.64 times the load to be expected from its ultimate tensile strength, this beam should carry 3200 pounds if 1 inch square and 12 inches between supports. If we use a factor of safety of 7, which seems liberal at first sight, we get a "safe" load of 457 pounds. But a load of 457 pounds figuring by the straight-line formula means a fiber stress of 8200 pounds. Looking at the curves of Fig. 5 we see that at 8200 pounds the two curves, tension and compression, lie in a nearly straight line through $O$. That is, within a reasonable limit of error up to and beyond 8000 pounds per square inch cast iron behaves very much according to the straight-line law. Therefore, with a factor of safety of 7, our beam would be stressed up to $\frac{8000}{35,000}$ of its full strength.

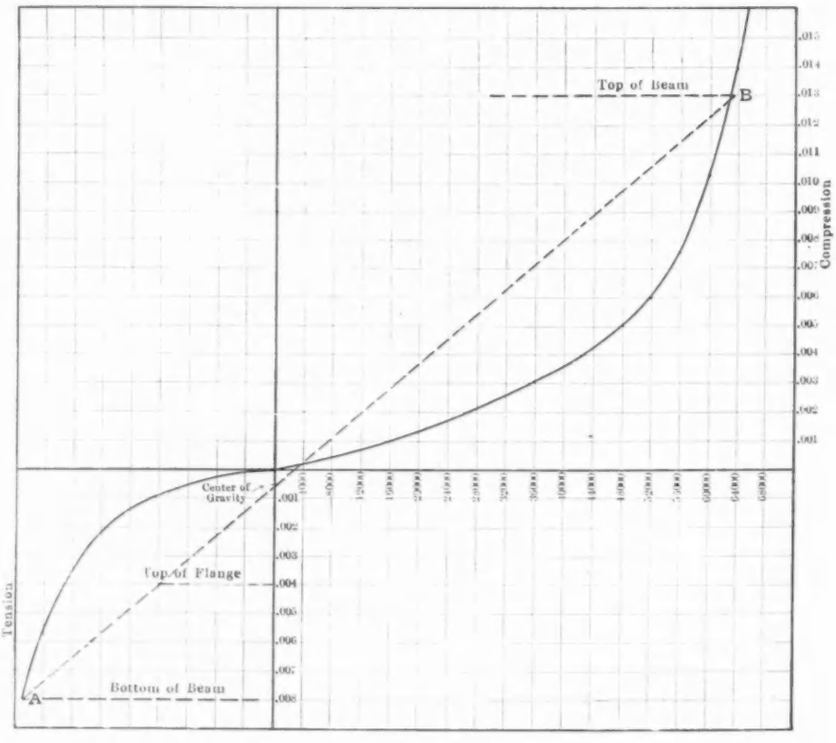



FIG. 7. STRESS-STRAIN DIAGRAM OF T-BAR

With such iron it would seldom be policy to design so that over 5000 pounds per square inch (1/7 by the breaking tensile

strength) would be brought on the tension side. This would allow us a load of 277 pounds, or only between 1/11 and 1/12 the full breaking load. This is merely another way of saying that designing to safe working loads is to be preferred to designing to factors of safety.

### Diagram of a T-Shaped Beam

So far we have considered only rectangular cross-sections. Fig. 6 represents graphically the distribution of pressures over the cross-section of a T-bar. The neutral axis is so placed that the *volume ABCDEF* is equal to the *volume EFGHIL*. To do this readily, since all that we desire is relative values, we will begin by drawing the stress-strain diagrams of Fig. 7 exactly as in Fig. 5, except that we need more of the curve on the compression side. For convenience we will say that the maximum tension on the lower side is to be 34,600 pounds and place the bottom of the beam as shown at that point. Then make the flange of the thickness shown and finally make the upper edge of the beam high enough to make the pressures above and below the neutral axis, balance.

Each section below the top of the flange is figured by taking the average horizontal length for the pressure and multiplying it into the hight of the section multiplied by the breadth of the flange. In this case I have taken the breadth of the web as 1 inch and the breadth of the flange as 4 inches. The pressures on each section above the flange are found in the same way. The pressures in this case balance 13 sections above the neutral axis which makes the total depth of the beam 21 sections and depth of flange 4. The center of gravity of a T-section of these proportions is 7.4 sections above the bottom as marked on the diagram, Fig. 7.

Drawing our straight-line diagram *A* to *B* through the center of gravity and computing the moments represented by this line and the curves we find that the curves represent a strength 1.75 times as great as the straight line. As before, if the iron were of the ordinary foundry variety with a limit of about 20,000 pounds for its tensile strength, the difference would have been necessarily more marked, for these commercial irons have compression diagrams very like the one shown in Figs. 5 and 7, even when their tensile strengths are much lower. As before, if the iron is to be loaded only to the safe tensile strength of the material, say 5000 pounds per square inch, the two curves approach sufficiently near to straight lines, up to that limit, to allow of the ordinary formula being used. A large enough factor of safety applied to any cast-iron beam to make it secure will bring it within this law, but it will have the apparent effect of introducing a larger factor of safety than is usual if the cross-breaking strength of a similar beam is used as a basis of comparison.

### Conclusion

In conclusion I would say that I was surprised to find so small a shifting of the neutral axis from the center of gravity, for that and the presence of internal stresses due to cooling have been the stock explanations for this increase in breaking strength of cast iron over that computed by the usual formula. The increase in the stresses carried by fibers between the neutral axis and the top and bottom of the beam seems, however, to be sufficient to explain the discrepancy. In some experiments that I made at the Worcester Polytechnic Institute with annealed and unannealed bars I found a marked increase in strength after annealing, but when the fiber stresses were completed after allowing for the increase in cross-section caused by the annealing, there was practically no difference. This too would seem to further strengthen my conclusions.

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## A Suggestion on the Drill-tang Question

By Robert B. Mann

I would like to offer the result of an effort I recently made to solve the drill-tang trouble and at the same time the drift-key trouble. The objects desired were:

First, a drive with or without a tang in any standard drill press with taper shank drills.

Second, a quick-release device with or without a tang on the drill.

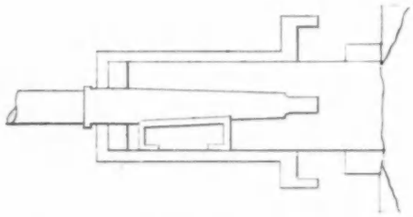


FIG. 1. ROUND KEY DRIVE FOR TAPER SHANK DRILLS

Third, a system that can be quickly applied to machines, drills and sleeves.

Fourth, for light back- or bottom-facing tools, a holding device that does not require taper pins or threads on the spindle.

Object one is secured by a round-key drive pin which lies in a slot shaped inside of the sleeve or spindle and milled on the side of drills at right angle to the tang. This key will drive with less bad effect than a square key and is easier to apply than a square key or any special key (see Fig. 1).

Object two is secured by reducing the drill to a standard diameter near the thick end of the taper and discharging the drill by a hardened disk pressed into a soft sleeve that can slide up and down on the spindle, and which discharges the drill when the spindle is raised until this sleeve strikes on an iron bearing around the quill. As enough room for the drill is needed, a little of the spindle end is cut off on some sizes. If desired the tang can be used to drive out the drill with a drift key, and in the case of tangless sleeves, a loose pin can be used in the end so that the sleeve remains in the spindle when discharging the drill.

Object three is secured by first making a set of jigs for those sizes likely to be

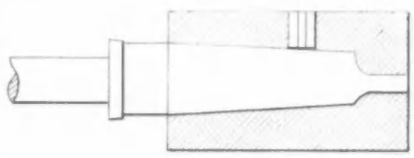


FIG. 2. JIG FOR DRILLING DRILL TANG

wanted (see Fig. 2). The jig can be made with an old drill, and will bring the location of the holes for the key wire alike so that when back-facing tools are wanted the location of the upper hole is correct in all spindles. By shaping all sleeves and spindles in the shop at one time the system is quickly started, and then all bars, centers and drills are milled at one time. This requires only two convex milling cutters, 1/16 inch and 1/8 inch. When new drills come in they are first sent to the miller and a slot milled on the taper part, which can be done in a few minutes. Then if the discharge part is not wanted, or the drill is wanted at once, the turning of this part can be dispensed with.

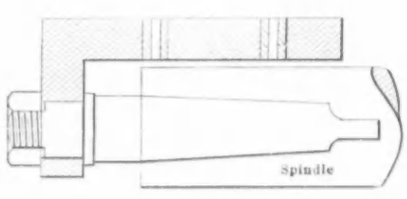



FIG. 3. JIG FOR DRILLING DRILL SPINDLE

Object four, for back-facing jig, Fig. 3, is made. On ordinary drills the slot is milled the whole length of taper, but if the slot in a back-facing tool is milled to a hole drilled at the upper end of the key, and then a through slot is milled alongside, you can see that by entering the tool with the key in through slot and then turning it until the key is in the short slot the tool can drive while lifting up the spindle to face around the bolt holes, etc., below. Of course, in this tool there is no tang, and if the tool is to be driven right and left, there must be two short keyways.

# Practical Letters From Our Readers

**A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy**

## WE PAY FOR USEFUL IDEAS

### Draw-in Chuck Operated by Taper Key

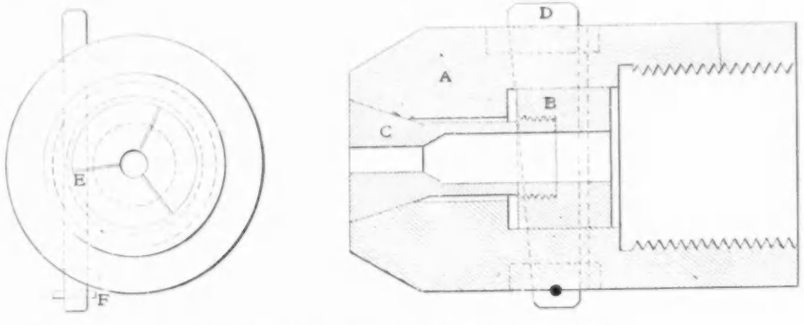
The sketch shows a special chuck designed for holding drawn brass rod on lathes not equipped with wire feed and automatic chucks.

Conditions called for a chuck that could be easily placed on any lathe, having a spindle nose of given size and thread, and one that would not compel the operator to reach to the rear end of the spindle to work a hand-wheel. Other conditions were that it should be of few parts and cheap. Our superintendent suggested that we adopt the same method that we had already employed in releasing threaded work from screw chucks without the aid of a wrench; that is, using a taper key, as shown in the sketch.

Referring to the sketch, *A* is the body of the chuck threaded at the end to fit the nose of the spindle and bored out to receive sliding member *B*. The front end is bored and the mouth tapered to receive spring collet *C*, which is threaded at the rear end and screwed into part *B*, as shown. Through the body *A* and offset enough to escape cutting into the thread on the collet, is milled a slot whose front end is tapered to a suitable angle for the key. One side of piece *B* is milled away for part of its length, enough being left at the end to form a shoulder against which the rear edge of the key bears. This, I think, will be understood from the end view at *E*. The slot in *A* is milled long enough to allow clearance behind the key, so that when driven in the key causes piece *B* to slide to the rear and close collet *C*, thus gripping the rod. To release the grip we simply strike the key on the opposite end with a soft hammer, the pin *F* preventing its falling out.

This chuck has been found to be very efficient and is rapidly operated. All parts are hardened and afterward ground to insure their running concentric.

Toledo, O. T. O. Loomis.




DRAW-IN CHUCK OPERATED BY TAPER KEY

### A Breast Drill Holder

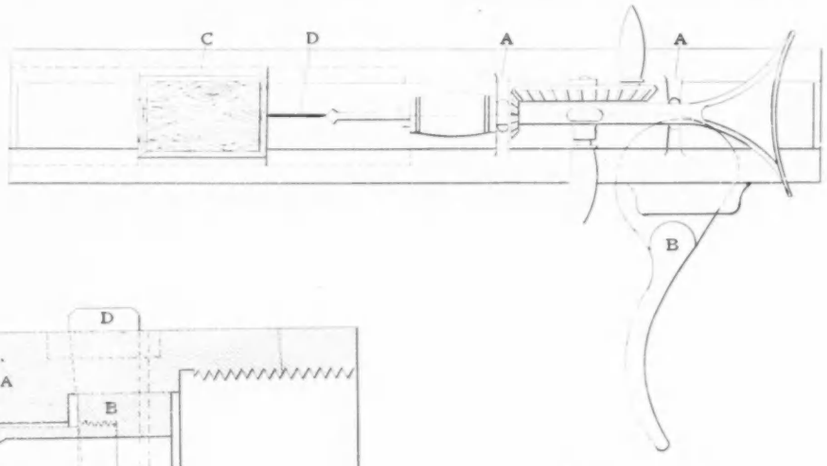
On one of my visits to a patternmaker friend I saw a neat kink of his. It was an ordinary breast drill mounted on a wooden framework, with a block of wood free to slide on the same and fastened by means of a stout wire to a swinging piece fulcrumed on the framework.

To show me what a range this device has he caught the frame in a vise, put a ⅜ of an inch drill in the chuck and rapidly drilled a hole in a piece of steel ½ inch thick. For a woodworking shop without a drill press this scheme is invaluable when one hand has to be free to hold the work.

*A* is the framework, *B* the thigh bar, *C* the work block, *D* the wire joining *B* and *C* and *A A* are the brackets that support the breast drill.

E. R. Seiter.

Chattanooga, Tenn.

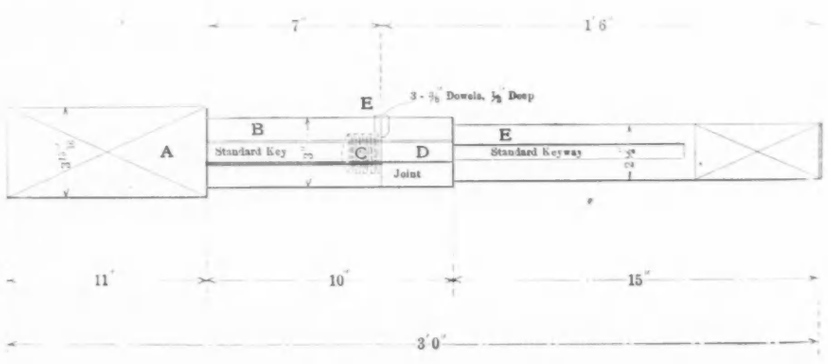



A BREAST DRILL HOLDER

### An Engine Shaft Repair

The accompanying sketch will probably show many readers a quick, new and substantial way out of a difficult job. The sketch is supposed to show a part of an engine crank-shaft. The shaft had to be lengthened 18 inches. The customer would not have the bearing *A*, or the fit *B* turned.

To weld a piece 18 inches long into *B*, and keep *B* perfectly straight and to size was considered a hard proposition. There-




AN ENGINE SHAFT REPAIR

fore, we simply threaded *B* and *D* and screwed them together, as indicated by *C*. Then we drilled three 3/8-inch holes ½ inch deep at *E* in the joint and drove three plugs in, then brazed the whole thing. After putting it in the lathe we found there was not quite enough stock on *D* to true up, so we then put it under the steam hammer and swaged it to proper position. When the whole thing was machined the joint was invisible except a seemingly golden thread, as it were. The object of the dowels was to take the torsion.

Los Angeles, Cal. WM. O. TORSEY.

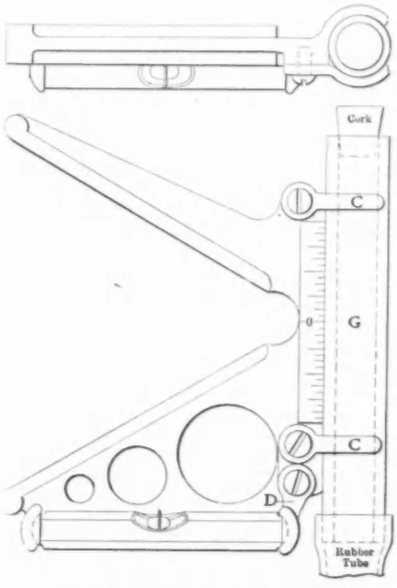
## A Water Level for Shafting

The water level shown was designed for leveling a line of shafting that is of different diameters and upon which there are many pulleys, as well as other things that are not fast to the shafting, yet are close and very much in the way.

The frame is made of gray iron, and the three clamping pieces *C C D* are made of bronze. The frame is finished on the surfaces where the clamps are fastened, on the graduated part and on the inside faces and rounded ends of the jaws.

The level is the ordinary one in common use; one of its ends fits into the frame casting, as shown, and the opposite end is fastened by the clamp *D*, which is slotted for the screw, thus giving adjustment to this end of the level. This adjustment is made while the rounded ends of the jaws are in a vertical line.

The glass tube *G* is clamped with the clamping pieces *C C*, and to its lower end is attached a rubber hose which can be of any convenient or required length and its opposite end attached to the other head, making the tool complete when filled nearly full of water.




A WATER LEVEL FOR SHAFTING

The cork shown is used while getting the device in place, but is removed to make the test.

Two operators are required to use this device, each one holding the jaws of a head against the side of a shaft in a level position, which is indicated by the level at the bottom, and noting the reading on the scale, the difference in the readings showing the amount of error.

Watervliet, N. Y. MARTIN H. BALL.

## A Horizontal Arbor Press

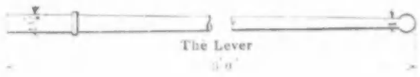
This arbor press was designed by me about three years ago and has proven a most useful addition to the shop equipment. Two men can exert about four tons pressure on the ram, which is ample for pressing arbors into pulleys.

Besides this it is used for many other purposes where moderate pressure is sufficient, being quickly and easily handled.

It will be noticed that the anvil is so arranged that the adjustment of the V-block up or down also regulates the opening of the movable jaws, being so proportioned that when the jaws are adjusted the right distance apart to allow the arbor to pass through, the V-block behind them is also the right hight for that particular size allowing the arbor to rest directly on it; this insures the proper alinement and prevents cramping the arbor in the hole of the pulley.

The illustrations show the assembled press and the principal dimensions.

Stamford, Conn. BONNETT.



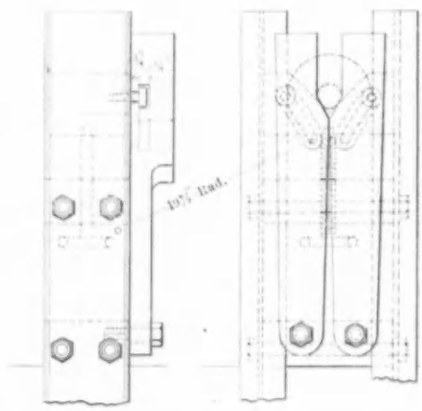




FIG. 2. LEVER AND DETAIL OF V BLOCKS

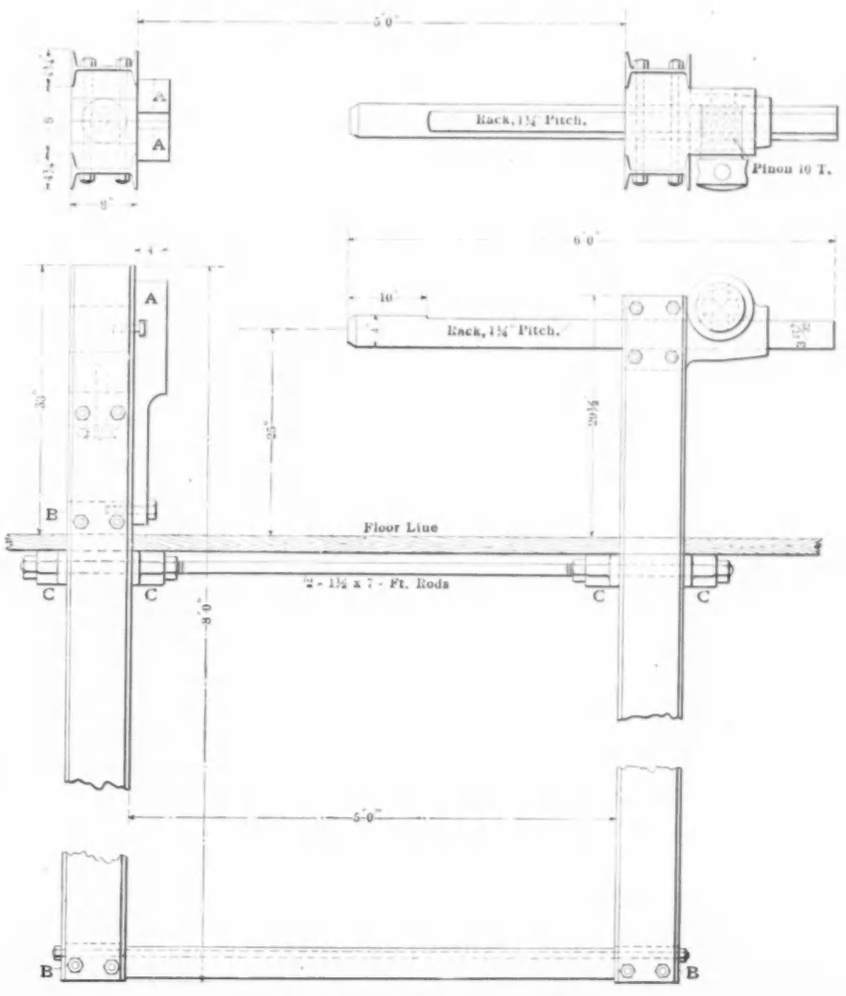



FIG. 1. HORIZONTAL ARBOR PRESS

## Making Watch Parts and Sub-presses

A few weeks ago I spent a couple of hours in the railroad shops at Springfield and then went over to the Coats watch-tool factory, and it was like going from the land of giants to that of the Lilliputians. Why, a thousand or more of the little pinions or balance staffs could be put in the space filled by a single chip from the shaper in the railroad shops.

### Finished Parts

The system of keeping the finished watch parts is shown in Fig. 1.

Each bottle bears a number corresponding to the catalog numbers in almost universal use among jewelers, and owing to

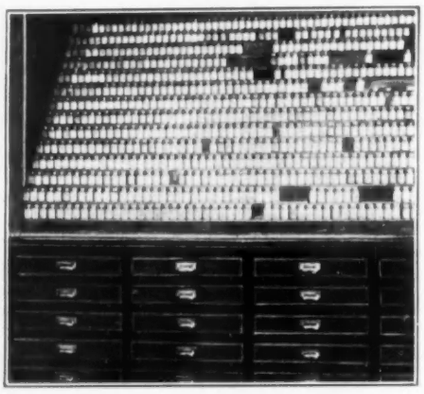


FIG. 1. HOW FINISHED WATCH PARTS ARE KEPT

the smallness of the parts an immense number are classified and stored in a small space. The drawers shown in the lower part of the case are used for watch tools.

### A Lapping Process

Naturally, where so much accuracy is required, a great deal of lapping is done. Fig. 2 shows one of the lapping devices.

The piece to be lapped is held in the lathe spindle by a draw-in chuck. The lap wheel at the left end of the spindle is of cast iron, charged with crocus; it is brought forward to the work by pulling on the lever in front of the head and is made to traverse the length of the work by pushing and pulling on the knob at the end of the spindle. These little machines run at a tremendous speed and a piece is quickly lapped the desired amount.

### A Wing Lap

Fig. 3 illustrates another form of lapping machine, called a "wig-wag." The work is held in the lathe exactly as in Fig. 2, but instead of a circular lap, a wing lap is used which saws back and forth at the rate of 1500 strokes a minute while the lathe spindle runs at 4500 revolutions per minute. In using these wing laps, four of which are shown in the foreground, one edge of the lap rests on the work and the other on a sapphire held in the tailstock spindle by a special holder; the sapphire being used to afford a bearing surface for one side of the lap that won't wear away.

These cast-iron wing laps are first charged with oilstone powder and then

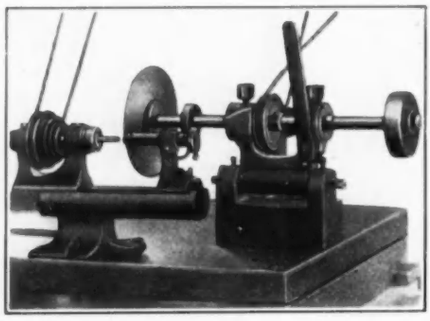


FIG. 2. A TAPPING PROCESS

the work is finished with one charged with crocus.

### Regrinding the Laps

When the laps become rough or worn they are placed in a fixture, provided with centers, and ground as shown in Fig. 4.

The centers of this fixture are so hung that the wing lap may be lowered, so that the bottoms of two wings rest on the block *A*. The whole fixture may then be swung back and forth past the face of the wheel and two wing edges ground at once. The process is then repeated all around.

### A Pinion Cutter

Fig. 5 shows a tiny pinion cutter. The body of the machine is a regular three-spindle precision milling machine, but the indexing device was made in the shop.

The gears cut in this machine are 0.107 inch in diameter and 0.075 inch long. The spindle on which they rotate is 0.322 inch long and 0.036 inch at its largest diameter, the spindle being taper. The index disk is notched to cut ten teeth.

In using this device one end of the pinion spindle is held in a draw-in chuck and the other end steadied by the tail center *B*. The gear cutter is shown at *C*.

### Case Hardening

Many of the small parts have to be case-hardened and this is done by packing them in tubes and heating in a gas furnace.

The tubes used are 2 or 2½ inches in diameter and about 6 inches long. The case-hardening mixture is made as follows:

Prussiate potash, 5½ pounds; salt, 10 pounds; sal soda, 15 pounds; hickory charcoal broken to size of a pea, one bushel; water, 2½ gallons.

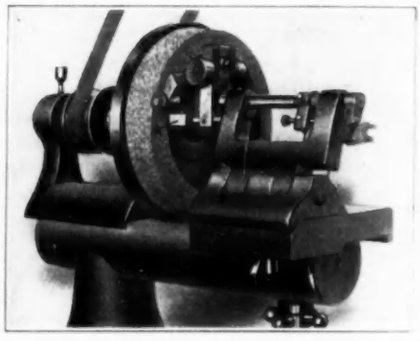


FIG. 4. GRINDER FOR WING LATHE

The small pieces are mixed with this and put in the tubes, the principal care being not to let the parts touch the sides of the tube. But little time is given for the parts to "soak" after being raised to a nice red, for the smallness of the parts and the strength of the mixture causes very rapid carbonizing. As soon as they are heated sufficiently, they are taken out and dropped into a fine-meshed wire basket immersed in clear cold water.

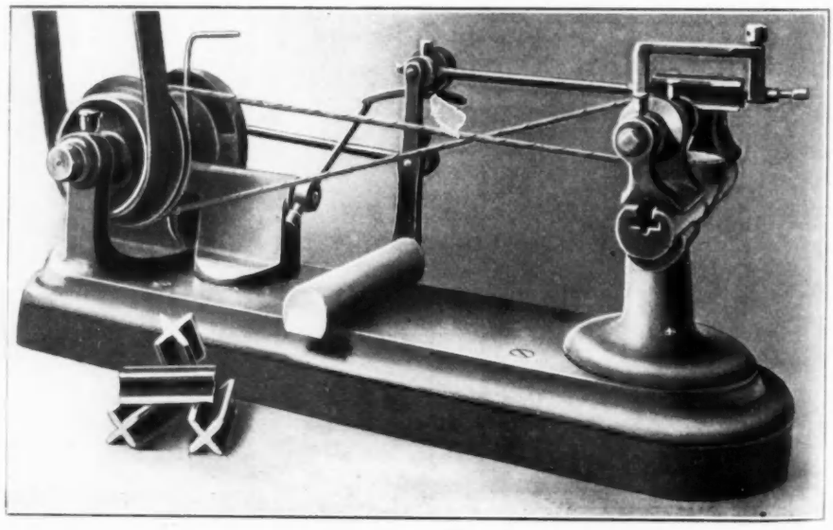


FIG. 3. A WING TAP

The drawing, Fig. 4, shows one of the four-post style of subpresses used in the Remington-Sholes typewriter factory. *A* is the top or sliding part and *B* the base or bed plate. Machine-steel posts, case-hardened in bone and charcoal and carefully ground to size are made a press fit in *a* and *b* and a close-sliding fit in *c* and *d*.

The dies and the plates holding the punches are doweled and secured by screws to *A* and *B*.

The T-slot in *A* is milled out and made a good fit for the steel plug *C* which goes

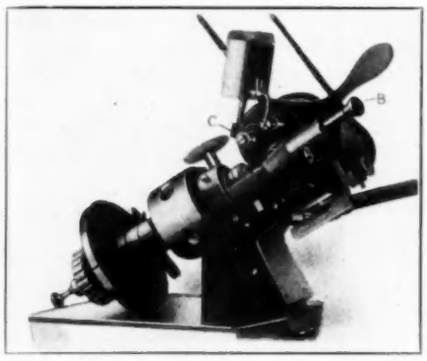



FIG. 5. PINION CUTTER

in the ram of the punch press. The holes *c* and *d* in *A* are not made the same size; this is to prevent any possibility of the plate being put on wrong by a careless workman.

Fig. 7 shows how the post holes are bored out on the drill press. Fig. 8 shows a two-post subpress with a small trimming punch and die doweled and screwed into place. In this subpress the posts are also of different size for the reason above stated.

All the dies used in the Remington-Sholes factory are pack-hardened, using one-half charcoal and one-half charred leather, and after being heated the right length of time to allow the steel to absorb

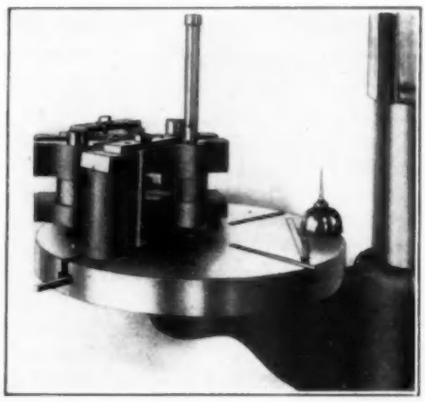


FIG. 7. BORING THE SUBPRESS POST HOLES IN THE DRILL PRESS

the carbon, they are quenched in raw linseed oil.

This method of hardening gives the least distortion or change of size of any method of treating tool steel that is in common use.

Decatur, Ill. ETHAN VIALL.

## Pitting of Steel in Barium Hardening Baths

I have found a number of users of barium chloride for hardening high-speed steel who are having trouble with a sort of pitting of the articles in spots. There seems to be a local melting so that a drop or tear runs down and leaves a hollow and a lump. Many times this does no harm but at others it makes the article unsalable and at best it is very unsatisfactory when this occurs.

Some only find this trouble at the higher hardening heats, say 2150 to 2200 degrees Fahrenheit, but others find it as low as 2000 degrees. This difference may, of course, be a case of unreliable pyrometers but in either case it is difficult to understand why a spot should melt and run at a heat so much below the melting point of the steel.

One theory is that a local overheating that takes place is due to particles of carbon from the crucibles and in evidence it is stated that this is particularly noticeable when an old crucible is broken up

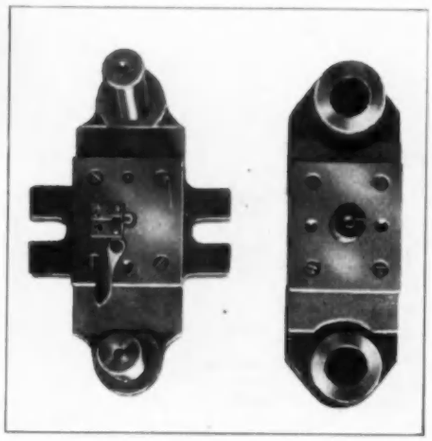


FIG. 8. A TWO-POST SUBPRESS

and the barium transferred to a new one.

Perhaps some of the users of barium may be able to throw some light on the subject.

New York. JOHN R. GODFREY.

## The Use of Balls on a Drill Press Table

Glancing through some old copies of the AMERICAN MACHINIST last night I saw a cut showing a drilling jig with balls between the feet of the jig and the table. This plan has been used in shipyards on the countersinking tables for many years. The tables of the countersinking machines are usually made of wood, rectangular in shape, say 20 to 30 feet long by 10 feet wide. A wooden rim runs around them about 2½ inches high. Distributed over the table are a number of rough cast-iron balls about 4 inches in diameter. The plates are laid on the balls and are then easily moved to bring them under the countersinking spindle.

New York. E. A. DIXIE.

It is reported in connection with new British inventions that owing to the success attained by certain flying machines, inventions relating to æronautics were more than twice as many as in 1906 and nearly five times as many as in 1905. A large increase is also observable in the subject of wireless telegraphy, and some attention was given to the transmission of portraits and designs by telegraphic means."

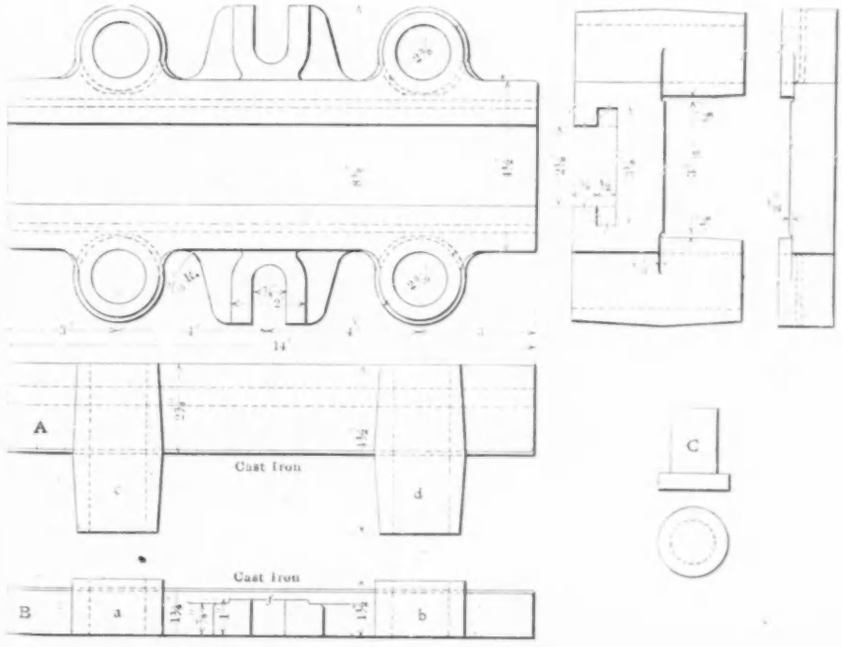



FIG. 6. SPECIAL SUBPRESS

# Discussion of the Previous Question

## Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

## WE PAY FOR THESE ALSO

### The Basis of Selling Prices

On page 98 appeared an article on "different ways of doing the same job," by J. Hindley, which was a discussion on a previous article under the same heading, by a correspondent, on page 654. These two articles show various examples of work which are done by different methods in different shops, and give a comparison of times which vary as much as two or three hundred per cent. in some cases, and yet the items operated on are intended for competitive lines, and the firm which takes the longest time in producing a given article sells the finished product at a lower price. This appears to somewhat puzzle your two correspondents, and on the face of it, it does seem somewhat funny, especially to the shop man, as your correspondents no doubt are; but had they been acquainted with the commercial organization of an engineering works, they would soon see that there are other factors which determine the selling price of a firm's goods. When the article is finally launched on the market, its selling price bears practically no relation to the time spent upon it in the shops. For instance, if firm No. 1 produces an article in the works at one-third the price of firm No. 2, the actual costs by no means end here, as firm No. 1 will have had to specialize on that particular work, and will therefore have spent several thousand dollars in equipping itself to turn out work cheaply. That means heavy shop charges, sometimes amounting to 200 or 300 per cent. on the actual wages paid to the operator for producing the given piece of work. Then again, highly organized firms, with elaborate tool-room systems, etc., naturally have to put a higher percentage of factory charges on than the old-fashioned firms who work more by guess, and usually add a fixed charge of about 50 per cent. In reality they never know what the amount actually should be; so that what it amounts to is this, that although a firm may specialize, and turn work out in the shops at half the price, or even less, than their competitors, it is not to say that they have to drop their selling prices accordingly and give their customers the benefit of it, as they have higher interest on capital, etc., to meet. On the other hand, their selling prices may be quite as high, with a good margin of profit, as the older fashioned firms, whose work cost much more in actual operators' wages, but whose shop charges are unknown, and profit perhaps nil.

RICHARD STACEY.

Liverpool, England.

### Expanding Arbor for Large Work

On page 930, Vol. 31 of the AMERICAN MACHINIST, I notice an expanding arbor, by H. Gang, which is a very good one for light work. Some little time ago we tried the same arbor, applied to a 24-inch Gisholt lathe for turning couplings. It will be noticed that the weakest part, that is at the small end of taper, has all the work to do and to resist all the strains due to cut. It quickly yielded and had to be scrapped, as when it was once bent we could not get it true again.

I then designed and made the one shown in Figs. 1, 2 and 3; it will be seen its strongest part, the largest taper end, is where all the resistance is required. It worked well and gave every satisfaction, as it is very easy to make and operate. Fig. 1 shows it applied to the Gisholt lathe chuck *A*, which is bored out 5 inches to receive it and key-wayed ¾ inch. *B* is taper arbor (taper 1 in 12) and fitted with ¾-inch feather *H*, drilled and tapped out 1 inch to receive the bolt *G*, which passes right through the lathe spindle. Bush *E* at rear end is operated by hand wheel *F*. Fig. 2 is end view of expanding bush *C*, which is cut right through with ⅜-inch slot at *K*, and the other 5 slots are only cut three-fourths of the thickness. The bush is steel. Fig. 3 shows smaller size of arbor.

In operation the coupling or pulley is placed on the arbor, and the bush *C* is forced in tight by the nut and washer *D*. It is then drawn up to the face plate by tightening up the bolt *G* by hand wheel *F* at the back end of the spindle. To relieve it the nut and wrench washer *D* are slacked off and the hand wheel *F* tightened up, withdrawing the arbor out of the bush *C*. I find to cut the bush, as described, relieves itself better than when three grooves are cut from each end. The above grips the work well, will stand very heavy cuts and it is not necessary to have a key in bush *C* to prevent slipping around on *B*, except on very large diameters.

Staffordsline, Eng. H. M. THORN.

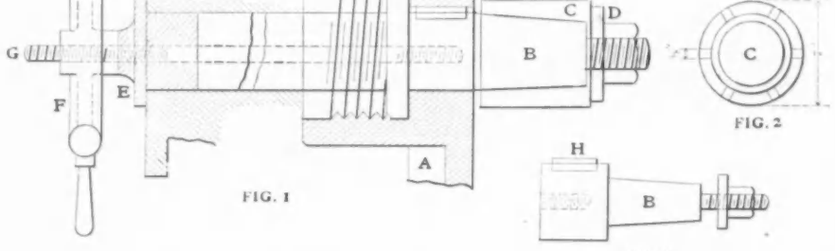



FIG. 1 FIG. 2 FIG. 3

EXPANDING ARBOR FOR HEAVY WORK

### That Mechanical Powderless Gun

On page 259 there is an item referring to a mechanical powderless gun which is claimed to project bullets by means of centrifugal force, and a larger one to be driven by a 50-horsepower motor is to "fire" 50,000 shots per minute.

These statements may sound very fine and promise the usual revolution of modern warfare, but it seems to me that before such claims are made the principle of the invention should at least be somewhere within actual possibility.

Let us see how near to 50 horsepower the energy output of this gun would be. In the first place we could assume that it would at least be equal to a modern rifle, and for comparison we could take the 6-mm. Lee straight-pull rifle which fires a 112-grain ball at a velocity of 2500 feet per second; this represents an energy of 1553 foot-pounds. Now it is obvious that if the centrifugal gun gives its 112-grain bullet an initial velocity equal to this, then each shot fired will represent at least 1553 foot-pounds of energy developed in the motor. We are told that the gun will fire

50,000 shots per minute, and, therefore, the power developed in the motor will be at least 50,000 × 1553 foot-pounds, or over 2300 horsepower, and if we take friction and other losses into consideration, it would certainly need a 2500-horsepower motor instead of the 50-horsepower one as claimed.

This is not the worst, however, for if the tremendous horsepower were the only obstacle it could possibly be made practical in forts, etc. But let us see what practical means we have of giving the bullets this high initial velocity. In the first place the vanes of the centrifugal projector must certainly have a circumferential velocity equal to the velocity given to the balls. Suppose this vane were made of steel weighing 0.2834 pound per cubic inch, then the tensile strain developed when rotating at a speed of 2500 feet per second could be 660,000 pounds per square inch. *There is no material known which would stand a strain of even half this amount.* Suppose we used some high-grade nickel steel which gave an ultimate tensile strength of 276,800 pounds per square inch. For a factor of safety we would certainly have to use at least 5 on account of the strains due to accelerating the balls as well as the strains of centrifugal tension. This would give a working tension of 55,360 pounds per square inch which is equivalent to a velocity of 724 feet per second—a mere crawl comparatively speaking, and would only give an energy of 131 foot-pounds to the ball. How can this gun become a factor in modern warfare?

Exeter, N. H. GEO. P. PEAKE.

I note on page 259 of the AMERICAN MACHINIST, the article regarding a new powderless gun, in which the velocity is imparted to the projectile from a rapidly revolving rotor. It is mentioned that the inventor claims to be able to discharge 50,000 projectiles per minute (size of projectile not mentioned) by using a 50-horsepower motor.

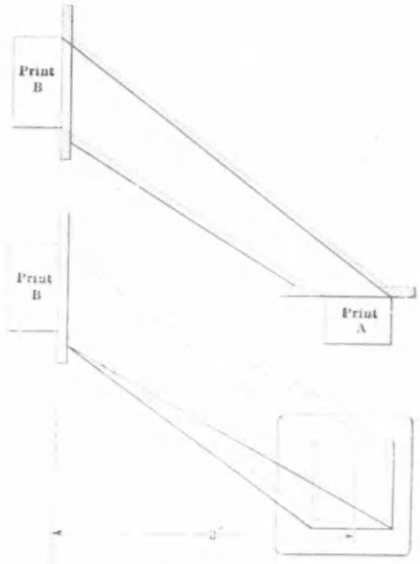
Referring to page 76 of the Winchester Repeating Arms Company's catalog for 1908, I find the energy of the 220-grain bullet for the 30-caliber United States gage magazine rifle, with which all United States troops are armed, to be 2286 foot-pounds at a distance of 50 feet from the muzzle. The discharge of 50,000 of these in one minute would represent the expenditure of 114,300,000 foot-pounds of energy, or 3463.6 horsepower.

Let us assume for the sake of argument that the rotor is 10 feet in circumference, which gives us a trifle over 3 feet in diameter. Referring again to the catalog, I find the velocity at 50 feet from the muzzle for the 30-caliber service bullet is 2163 feet per second. To attain this velocity the rotor would require 216.3 revolutions per second, or 12,978 revolutions per minute, which is certainly "going some."

Portland, Oregon. F. W. C.

## Another Difficult Core

The letter, on page 97, by a Birmingham reader entitled "A Difficult Core" brings to mind a case I had to deal with which might prove interesting to your readers. The core in question was for a malt shoot, that was on the skew both ways, and this made the sides irregular curves instead of plain straight faces. The metal was only required to be ⅜ of an inch thick, which increased the difficulty obviously. To make a corebox would have been a long and expensive job, which might not have been accurate when finished. The way the




SECTION AND FRONT VIEW OF SHOOT FOR MALT

job was done, was first to make the pattern, as shown in the line cut, with prints *A* and *B* six inches long, then when the pattern was drawn from the mold strips of wood equal in thickness to the ⅜ of an inch of metal required were laid in the bottom and sides of the mold and the core was built up in this. The core was then lifted out with the strips and dressed off to the guide marks left by the strips when they were away from the core. The mold was then cleaned out and when the core was put back it showed an equal ⅜ of an inch of metal all over, without the necessity of making a corebox.

Preston, Eng. HARRY CORNELL.

## The Grinding of Copper Rolls

The description of copper-roll grinding on page 133, was of much interest to me; but is there not some mistake in the grade letter of the wheel as given? I am writing this because my own experiences of grinding copper and those of many people I know have not been attended with success, so that any information that is helpful should be of general value. The writer speaks of a wheel of 46 B Norton grade, but has evidently made a mistake in the grade letter for I do not think the Norton company make a wheel as soft; unless it is a specialty. Moreover, it does not seem as if it would be safe to run so soft a wheel at 7300 feet per minute, which is the speed given. Copper seems to have the peculiar attribute of rapidly tearing the grit from the wheel, however hard it may be, and so a high surface finish is almost impossible. At least that has been my own experience, and that of all others I have spoken to on the matter. Bronze and similar alloys are ground with little trouble, using about a 60-grit wheel of medium grade, but I have tried to grind copper with both hard and soft, coarse and fine wheels without meeting with much success. As the writer speaks of the surface finish being all that can be desired in this case, he may be able to furnish us with more information, or possibly some other reader may help in the matter.

London, England. A. B. SCHLIEFER.

## Some Vicissitudes of the Job Shop —The Skewer Pointing Machine

I have read Mr. Blanstein's criticism on the article which appeared on Page 837, Volume 31, Part 1. Now I am not at liberty to disclose the principle applied to this pointer even at this late day, since it is still a carefully guarded secret.

I will, however, send a sketch to the editor of the AMERICAN MACHINIST to justify the statement that a machine built along the lines suggested by Mr. Blanstein would be, in the light of the knowledge of the skewer pointer already invented, nothing short of an absurdity. Just imagine, if you please, a machine with one spindle and two knives pointing about 20,000 per hour, the skewers at no time traveling faster than 40 feet per minute, no feeding tubes, no chucks, no excessive speed which is so detrimental to the life of all machinery. Of course, I presume that he suggested the idea which appealed to him most. He probably knows that a machine becomes valuable as an asset and investment at almost any reasonable price when from 60 to 80 per cent. of its parts are eliminated, and thereby the efficiency is increased in the same ratio and all to the disadvantage of a competing machine.

Mr. Blanstein seems to have lost sight of his criticism. For if a machine of the type suggested by him were built with proportions liberal enough to insure long life at a high speed, and brought to a successful issue after experimenting, to which expense add the price you would be justified in charging for inventing a machine,

the success of which would mean hundreds of thousands of dollars to the man for whom you are building it (making patterns for a machine such as he proposes would be no small expense); all of this, and three or four complete working machines with the knowledge that no more machines will be needed, then indeed $15,000 would be small recompense. If he succeed in inventing a machine just like the one now in existence, and would value his inventive ability so small, and would build a number of machines for less than $15,000, then he belongs to that class of "charitable old men" referred to in his criticism.

When you bear in mind that the concern offering the bribe of $15,000 had money to back them, but could not make a profit without the pointer, that they would have to lose everything, then I fail to see where any "charitable old men" entered in this case.

It has been no later than last fall when an offer was made, by a concern just starting in business, of $800 for a machine that can be bought of any one of at least three concerns for $50. In this case it was either that the manufacturer did not advertise enough, or that the buyer was unfamiliar with his prospective business. I suppose that if this came under Mr. Blanstein's notice he would characterize it as an old man's charity, or a fairy tale.

Now Mr. Blanstein offers a solution suggesting a series of knives, and then hedges by using the word "probably" before the word "series" in his criticism, on page 99. He also seems to think that 20 years ago, competent designers were a widely distributed race; it seems to me that that condition does not even obtain at present at least in some localities. It is assuming a whole lot to think that a man needs but to know that a machine has been built to simplify invention.

And again he says, "knowing that such a machine has been built, all there is to it is to find the best means to accomplish the end." When a famous sculptor asked how he got his results he answered, "By removing all material which is unnecessary." He also says, "It is only a matter of experience and judgment, and there are no mechanical movements impossible." Now if it requires only experience and judgment attended by a thorough knowledge of mechanical movements to become an inventor of a valuable and useful machine, how does he account for the fact that those in possession of that knowledge are rarely inventors? Just look around and verify this. Usually the successful inventor gets a hobby to improve a thing, and I believe that generally the required movements (to him) are reinvention rather than applying movements already known.

The moral in the article was my sole aim in writing it, yet it had the merit of being based on absolute fact.

Cleveland, Ohio. J. G. DORNBIRER.

## The Precision Level

Notwithstanding the evidence brought forward, at page 61, by your commentator, Oscar J. Beale, your editorial, at page 696, Part I, on "The Precision Level," was not untimely. Mr. Beale cites a few cases where the serviceability of the sensitive level has been recognized, to which examples I will add that of the Newall measuring machine, described in the AMERICAN MACHINIST about six years ago, where a level is used as a comparator, but these only go to prove the case as exceptions to the general rule. To the average mind, the limit of application of a spirit level is the leveling of shafting and of machine beds, and the article generally used for these purposes is an abomination in the shape of a piece of bent glass tube filled with spirit, rarely sensitive enough, frequently inaccurate and practically never with the bubble movement expressing a known quantity to the user, further than an indication of the end to be raised or lowered; the amount must be guessed at.

An accurate and really sensitive level is a thing of beauty in its precision, and in addition to its superiority for ordinary use, it can be applied to other purposes to great advantage. As a test indicator, for instance, to test the accuracy of a number of pieces of similar size, it is without equal.

Acting on the common rule of taking things for granted, it is surprising the number of people who believe a level to be a straight glass tube, although it does not take much consideration to recognize that a straight vial would be useless for a level. An idea of how spirit-level vials are made and tested may be of interest.

DEVICE FOR TESTING AND GRADUATING

Both the common and the ground vials are tested and graduated on a very simple device, an idea of which is given in Fig. 1. This consists of a steel arm carrying a micrometer screw at one extremity and supported on trunnion bearings at the other. About the center of the arm, the position is not material, is a pair of V's into which the vial is laid for testing. The micrometer screw carries a graduated disk with divisions according to the length of the arm; if the arm is 21 inches long between the centers of the trunnion and the micrometer screw, and if an ordinary micrometer screw of forty threads is moved 1/25 of a turn, or 1/1000 of an inch, the movement of the bubble will represent 10 seconds of arc. In graduating the vials the micrometer dial is set to zero when the bubble is in the center of the vial when resting in the V's; the screw is then set to give the required movement of the bubble in seconds of arc, when its new resting place is lightly marked on the glass with a diamond. After a sufficient number of these graduations have been made,

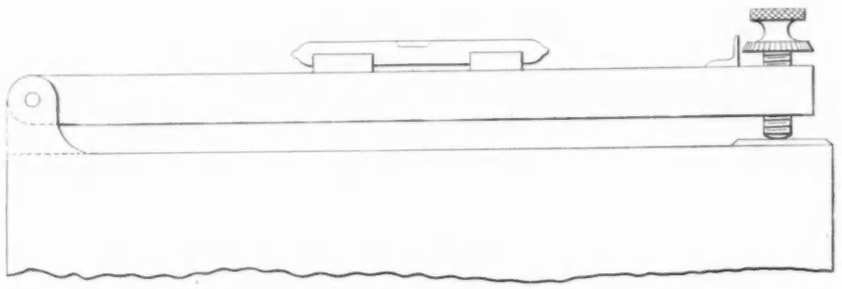


FIG. 1. INSTRUMENT FOR TESTING SPIRIT LEVELS

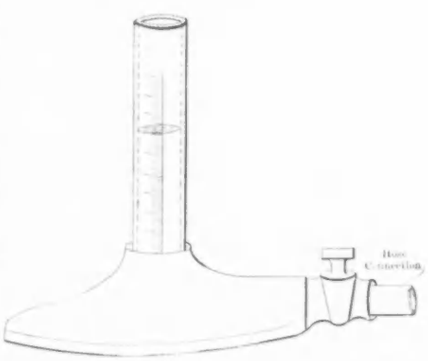


FIG. 2. WATER LEVEL FOR LONG DISTANCES

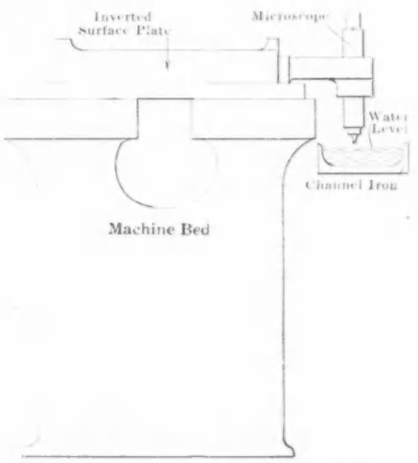



FIG. 3. METHOD OF TESTING LONG MACHINE BEDS

the vial is removed and the marks made permanent.

The making of common or unground vials is merely a matter of selection, the difficulty being, not in avoiding too much or too little bend in the tube used, but in tubing that has a twist in it. The curvature of the vial is not, within limits, of great importance, as will be shown in the manner of selecting. After filling the tube and sealing the ends (corks may be used for a preliminary test), it is placed on the testing arm in such a position that the crest of the curve is on the top. It is then roughly tested by the micrometer screw, and if the bubble is not sufficiently sensitive in its movement, the vial is moved round in the V's, so the crest of the curve is not then on top, until the required sensitiveness is obtained, after which the graduating is proceeded with. It will be seen that, by setting over the vial so that the crest of the curve is *almost* at right angles to the top, comparatively sensitive levels can be made,

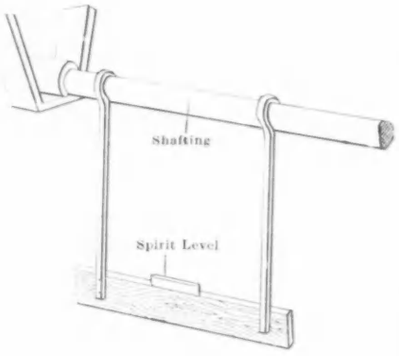



FIG. 4. RIG FOR LEVELING LINE SHAFTING

but the trouble is to avoid irregularities and twists in the tube, and on this account only short vials are made in this way, and they are not to be compared with ground vials, which can be made any required length.

### GRINDING VIALS

There are two methods of grinding spirit-level vials; some are machine-ground, but by far the most common are the hand-ground, and these are not nearly so accurate as the former. The hand process consists simply of correcting the irregularities in the glass tube by means of a circular pad charged with abrasive and rubbed on the inside of the tube where the irregularities are until the desired curvature is obtained. One end of the tube is left open to admit the pad, a cork being used to hold the liquid in during testing. These are the commonest of ground levels, and may be detected by the fact that the grinding marks only appear on the top inner surface of the vial.

Another method of hand-grinding is to spring the tube to a curvature by a simple arrangement of clamps and then lap a *straight* hole through by means of a long, cylindrical lap, when after removing the clamps, the curvature will be in the inside of the tube only.

Machine-ground vials are produced so that their interiors are left barrel-shaped, and they are reliable in the uniformity in the movement of the bubble, a point where others fail.

The precision level of high sensitiveness does, as Mr. Beale says, shock one's belief in the stability of things, being, like all other instruments of precision, susceptible to extraneous influence in ratio to the effectiveness in detecting error, and should be handled with care. It is remarkable the amount of movement that results from placing the finger tip on the vial of a level. The reason is simply that the local heating produced by the finger causes expansion to take place at that point on the glass and alters the curvature; the bubble, of course, seeks the highest spot which is immediately under the finger.

The serviceability of spirit levels would be increased if makers would engrave on the bodies the value of the vial graduations in seconds and its equivalent in inches per foot, so that anyone could easily translate the movement of the bubble into a tangible quantity.

### METHODS OF LEVELING

While on the subject of levels, Figs. 2, 3 and 4 illustrate some methods of leveling; originality is not claimed for these, but they are not in common use and might be serviceable to some at any time.

Fig. 2 consists of a graduated glass tube set in a suitable base with a hose connection and a water tap. A pair of these, connected by a hose pipe, and filled with water showing to a convenient hight up the graduated tubes, is sometimes very handy for leveling at distances wide apart, where a more accurate method is impracticable or unnecessary.

Fig. 3 shows a method of scraping or truing very long machine beds to a water level. A microscope attached to the ribs of a surface plate is focused on the surface of the water, and after the machine bed has been set in focus at each end any intermediate spot may be tested. A length of channel iron filled with water serves very well as a water level. A fine degree of accuracy can be obtained in this way.

Fig 4 is a simple device for truing up shafting and saves a lot of ladder climbing. It will require no further explanation than that it is made of two hooks of steel about half an inch square in section strapped to a wooden board about 7 feet long. The length of the hooks should be such as will make it convenient for the operator to work from the floor.

Manchester, Eng. J. E. STOREY.

## Using Broken Twist Drills

Some time ago a scheme was published for using up broken twist drills. The cut shows how ends of drills are taken care of at the shop where I am employed. This scheme is used on drills 5/16 inch and less in diameter.

A broken taper-shank drill is used having a No. 1 Morse taper. A hole is bored in the taper shank corresponding to the size of the drill to be used. The smaller end of the taper is ground 1/64 inch smaller than the standard size, leaving the larger end full size for about 1¼ inches. Three slots are then milled and the chuck is ready for use. These chucks are used with standard Morse sockets and will hold a drill without slipping.

I would like to add my voice to the crowd who value the ads. in the AMERICAN MACHINIST. I always look them through before the reading pages receive attention. There is one which I have never looked at and which has appeared in many issues. This ad. has been put into the publication bottom side up. I am not in the habit of reading while standing on my head, and time is worth

CHUCK FOR BROKEN DRILLS

too much to bother to turn the paper around. I suppose that ad. was printed that way to attract attention; in one case it has done so, but I am still ignorant of what the company manufactures and what they have for sale.

Stroudsburg, Penn. POKONO.

## A Time Recorder for Machine Tools

Referring to H. A. Dudgeon's article, on page 954, Vol. 31, Part 1, I think that he has overlooked one very important feature in connection with the time recorder for machine tools. The feature is this: The card record shows to the foreman important facts more plainly than they can be put before before him in any other way. For example, in looking over some of the first cards I found that the time of stopping was much longer than the actual time for working; that is, too much time was wasted in taking out the work and putting in a fresh piece. I immediately went to the machine and devised a quicker method for handling the work, and thereby we are saving several hours on each lot of pieces. With reference to the point that the operator, who is so inclined, can waste time by running his machine lightly, I wish to say that if the hourly or daily production is held to the proper standard this objection of waste cannot exist.

WILLIAM LODGE.

Copenhagen, Denmark.

# AMERICAN MACHINIST

Issued Weekly by the

## Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any postoffice in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.


*CIRCULATION STATEMENT*

*During* 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST. *Our circulation for August,* 1908, *was (weekly, monthly and European)* 89,500.

| | |
|---|---|
| *Sept.* 3 | 33,250 |
| *Sept.* 10 | 18,750 |
| *Sept.* 17 | 18,750 |
| *Sept.* 24 | 19,500 |

*This paper reaches* 33,250 *separate readers each month and* 19,500 *each week.*

*None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.*

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## The Wright Brothers' Flying Machine

About the most grudging recognition of meritorious effort in the most difficult field of work which exists in mechanism that has ever come to our knowledge appears in *Engineering* for August 14, under the title, "Recent Aeroplane Experiments." This was written immediately after the first flights made by Wilbur Wright in France, and in view of the recent work of Orville Wright in Washington, the article is thoroughly grotesque.

After referring to the "wonderful, not to say incredible, reports of their prowess which have been published," the article goes on to say, "The mystery surrounding their achievements has no doubt been largely responsible for the imaginative stories which have found their way into the papers, and now that the mystery lasts no longer there is a tendency to magnify the actual feat to the dimensions that the public has been taught to expect." The article then details the brief flights which at that time had been made in France, and goes on to give the terms of a contract between Mr. Wright and Mr. Weiller, by which the latter will purchase the aeroplane for 20,000 pounds sterling should it succeed in carrying two passengers 50 kilometers, or a little over 31 miles, before the end of the year. Regarding this contract the article says: "Confidence is expressed in many quarters that the contract will be fulfilled, and we hope that it may, although the results so far do not seem to us to justify any very great expectations." The article is generous (?) enough to admit that "the number of men who have done even so much could probably be counted on the fingers of one hand," but it adds, "It must be confessed that the performances fall very far short of the promises, and there has been very much cry for remarkably little wool."

In view of Orville Wright's achievements in Washington, during which, at this writing, he has on several occasions remained in the air for more than an hour, we wonder how the author of this remarkable article feels about it at the present moment. To complete his discomfiture, his article concludes by saying: "Every successful flight we have seen, whether of models or of full sized machines, has been in an almost absolute calm. The faintest breath of wind upsets the stability of these great structures with their extended wing surface, and as yet, in this respect, so far as trustworthy information goes, Mr. Wright has met with no greater success than other experimenters."

It so happens that one of Mr. Wright's Washington flights was made in a 10-mile breeze, according to official measurement, and while this is far from a heavy wind, it is also far from "an almost absolute calm."

We regard the achievements of the Wright brothers as the most wonderful thing that has ever been accomplished by pure mechanism. Some of the developments in the field of electricity may be fairly placed beside it, but in mechanism pure and simple it is the crowning triumph of all the ages. Since the dawn of human intelligence on this planet man has envied the birds. The problem of mechanical flight has been the dream of all mankind before us, and today it is an accomplished fact, for the Wright brothers fly as the birds fly.

Three years ago practically no one believed such flight to be possible, and now that it is accomplished the most remarkable thing about it is the simplicity of the means by which it is done—a fact which already tends to minimize the wonderful results that have been accomplished. Yesterday the difficulties were believed to be insurmountable; today they seem small, and tomorrow they will be forgotten; but that does not alter the fact that the Wright brothers have accomplished the greatest piece of mechanical work ever done by mortal man.

We expect to publish in our next issue the first detailed description of the Wright brothers' machine. The article will be fully illustrated by half-tones from photographs taken especially for us, and it will show what has not been shown before—the mechanism of the machine and how it works.

## The Federal Compensation Act

On August 1 last, an act went into effect granting to certain employees of the United States the right to receive from it compensation for injuries sustained in the course of their employment. The employees embraced by the provisions of this act are: Any person employed by the United States as an artisan or laborer in any of its manufacturing establishments, arsenals or navy yards, or in the construction of river and harbor or fortification work, or in hazardous employment on construction work in the reclamation of arid lands, or the management or control of the same, or in hazardous employment under the Isthmian Canal Commission. If such an employee is injured in the course of such employment he is entitled to receive for one year thereafter the same pay as if he continued to work. Such compensation is paid under regulations of the Secretary of Commerce and Labor. However, no compensation is to be paid if the injury is due to negligence or misconduct of the employee who is injured, or unless the injury incapacitates the employee for more than fifteen days.

In case an employee dies during the year succeeding the date of the injury and leaves a widow, a child or children under 16 years of age, or a dependent parent, such dependent persons are entitled to re-

ceive the same amount for the remainder of the year as the employee would be entitled to receive as pay if he were alive and continued to be employed.

Further, every employee shall submit to a medical examination as often as required by the Secretary of Commerce and Labor, and at least once in each six months. Such examination is to be provided and paid for under the direction of the secretary, and any employee who refuses to submit to such an examination loses his right to compensation for the period covered by the continuation of such refusal.

The spirit of this act is in keeping with the growing sentiment that industry must bear the expense of the economic losses of its employees. It should be unnecessary to point out that a large number of machinists will be entitled to compensation under this act in case of injury, for it embraces the employees of arsenals, navy yards, and all other manufacturing establishments of the United States.

## The Trade School Movement in New York

The Education Department of New York State has issued the following circular:

Announcement is made that through the organization of a new division of trade schools the Education Department is prepared to take up the organization of factory and trade schools with local school authorities, commercial or labor organizations, or any other citizens who may be interested. All correspondence upon this subject should be addressed to Arthur D. Dean, chief of division of trade schools, Education Department, Albany, N. Y. Where the circumstances justify it, Mr. Dean will journey to different parts of the State for conference with boards of education, and for the presentation of the theme at meetings of organizations and citizens; but, obviously, this ought not to be asked until local discussion has already awakened interest and the attendance of a representative of the State department is likely to have some concrete result.

If you have not already received printed matter, showing in a general way the thought and plans of the department in this important educational movement, Mr. Dean will forward the same upon application.

To avoid confusion and unnecessary correspondence perhaps it may be well to say:

1. The point of this movement is the training of workmen in craftsmanship.

2. It looks to the organization of two classes of schools: (a) *factory schools*, which train for work in factories where there are many employees who work with much machinery; and (b) *trades schools*, which train for the constructive trades, in which the work is essentially individual, and independent of machines.

3. The new schools are to be a part of the school system, be subject to its management and articulate with its other parts, but their work is not to be mingled and confused with the work of other schools. They are to occupy rooms, have courses of work, and teachers of their own.

4. The State will make an allotment of $500 to the board of education for each of said schools, with not less than 25 pupils, maintained for a minimum period of 40 weeks in one school year, and an additional $200 for each teacher, after the first, employed in such school for the same period; but only when the requirements of the Education Department as to rooms, equipment, and qualifications of teachers are complied with. For the present year the department will consider applications for an equitable allowance of a part of the State quota for a less term than 40 weeks.

5. It should be clearly known that manual training schools or classes cannot be accepted for a factory or trades-school allotment; that no teacher can be approved who is not a proved mechanic; and that no recognition can be accorded to a factory or trades school which does not amply provide for the substantial instruction of pupils in general mechanics, or in a particular trade, and which does not attract the regular attendance of a number to justify the expenditure.

6. It is advised that the system be organized upon an economical footing. Often an idle building, erected for a factory, or some other purpose, may be used. These schools should be organized not merely to make a show of doing something, but in response to a real demand, and the system must be flexible enough to meet every substantial demand which comes within the scope of the general purpose for which the State is recognizing such schools. It is suggested that boards of education advise with local commercial and labor organizations, and invite expressions from the press and from citizens; and that where a real demand appears for training in general shop work, or in any particular trade, steps be taken to meet it. When this time comes at any point in the State, the chief of the division of trades schools will be glad to be of such service as he may.

7. Just now it is not deemed best to prescribe hard and fast general rules to which all must conform. That will doubtless be done a little later. In the time being we must not lose sight of the vital points which will insure the training of workmen upon a basis to which no fair objection can be made. To this end the chief of the division of trade schools will for the present be glad to confer with interested parties and consider individual cases.

All correspondence will be welcomed by Mr. Dean. It is the very earnest desire of the Education Department to meet a serious and widespread public need, and to do it safely and efficiently. It must be done upon a plan which will be reasonably free from abuse, and which will establish mutually helpful relations between the educational and industrial activities of the State. And we may as well all remember that we are breaking out new roads which seem imperative to the public need, and that we must have patience while we find the true and safe paths.

Very sincerely yours,

A. S. DRAPER,
Commissioner of Education.

Albany, N. Y., September 10, 1908.

## Personal*

Carleton A. Read, formerly professor of mechanical engineering at the New Hampshire College, has now become professor of steam engineering at the Worcester Polytechnic Institute.

Charles H. Turner, who was for some time employed by the American Car and Foundry Company as a designer, has recently accepted a similar position with the Standard Steel Car Company, Butler, Penn.

C. L. deMuralt has been re-appointed professor of electrical engineering at the University of Michigan for the coming year and will continue his course of special lectures which met with widespread attention last year.

John M. Young, who has held a position as structural engineer with Westinghouse, Church, Kerr & Co., for some time, has accepted the chair of Dean of Engineering, College of Hawaii, Honolulu, Hawaii.

J. Henry Sirich, Jr., who was formerly turbine engineer with the Westinghouse Machine Company, has recently joined the organization of the Bethlehem Steel Company, having accepted a position in the power department.

G. W. Lake has resigned his position as superintendent of the Cell Drier Machine Company and the Tudor Manufacturing Company and has accepted the position of general superintendent of the new plant of the Wright Wrench Company, Canton, Ohio.

## Gardner Dexter Hiscox

Gardner Dexter Hiscox, an author of considerable prominence in engineering circles, died after a brief illness on September 12. Mr. Hiscox was born in 1822, and early in life took a marked interest in engineering work. His education became the result of home study, and while without a college training, he became an author of numerous technical works.

*Items for this column are solicited.

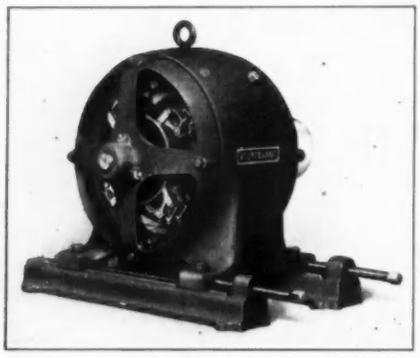
# New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

## THE LATEST INFORMATION

### A New 4-Pole Continuous Current Motor

Although this motor was designed especially for driving fans, it is well adapted for general work and is the most compact and efficient motor built by this company. It is built in a full line of standard sizes from 1 to 100 horsepower, and is open, inclosed, or semi-inclosed to meet all conditions of modern service.



A NEW 4-POLE MOTOR

Tests conducted in clean dry places have shown the motor capable of carrying a 50-per cent. overload for an hour without destructive sparking or heating and 100 per cent. overload for five minutes. The armature has been especially designed to secure the best ventilation so that the heat rise for open and semi-inclosed types is less than 104 degrees Fahrenheit at normal speed and output.

The armature, of the iron-clad, slotted-drum type is built up of soft annealed sheet-steel punchings insulated from each other by a coating of japan. The laminations are assembled on a cast-iron sleeve which has openings for the free circulation of air and also an extended hub for the reception of the commutator shell.

The commutator is built up of bars of hard-drawn copper, securely held in a cast-iron shell of spider construction. The whole commutator is assembled while hot under great pressure so that every bar is held firmly in place and cannot work loose in service.

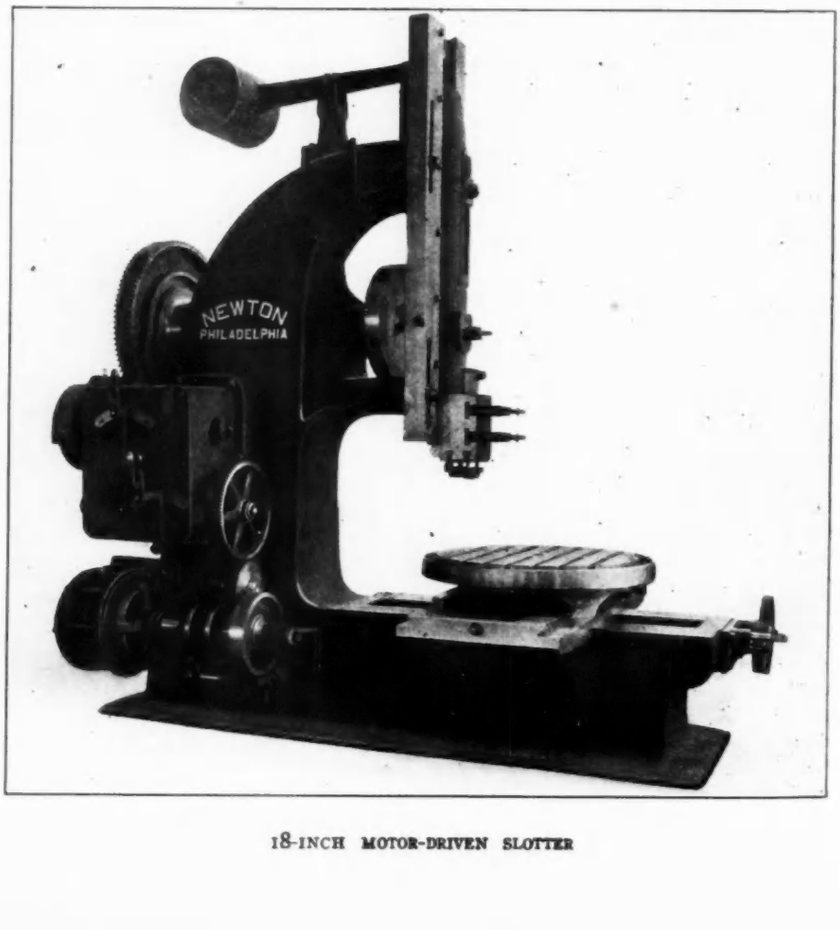
The brush holders are supported by a ring of spider construction which is supported in a recess machined in the magnet frame. The front bearing bracket, or end cover, clamps this ring in place so that there is no chance for the brushes to work out of position or become tilted even though they are easily shifted. The brushes themselves are of carbon. Each brush holder is provided with a braided copper cable shunt or pig-tail which relieves the holder body and springs from carrying any current.

The magnet frame consists of a cylindrical yoke of cast-iron of high permeability, the supporting feet being cast solid with the frame. Each end of the frame is machined to receive the bearing brackets, and on the inside the frame is machined to provide seats for the pole pieces which are through bolted to the frame. The pole pieces are located off center with respect to the frame so that the bearing brackets for each end may be duplicates. The pole pieces are built up of soft-steel punchings, riveted together between end plates while under pressure. The punchings are of such shape that they support the field coil and so distribute the magnetic flux that there is sparkless commutation even under wide ranges of load. The motor is made by the B. F. Sturtevant Company, Hyde Park, Mass.

### An 18-inch Motor Driven Slotting Machine

This is an 18-inch slotting machine recently supplied the Portsmouth Navy Yard, by the Newton Machine Tool Works, Inc., Philadelphia. It is driven by a 10-horsepower motor, clutched to the flywheel shaft, the clutch being operated by a lever on the other side of the machine. The same lever also operates the friction brake shown under the flywheel; this is adjustable for wear.

The speed box is of their standard design, giving nine changes of speed with only nine gears, and allowing a variation of from 6½ to 67 strokes per minute. The cutter bar has a relief-tool apron with vertical and horizontal clamping surfaces, which fit corresponding grooves in the yoke washer, and insures rigid clamping as well as taking the strain from the adjusting screws. The cutter-bar slide can be adjusted to support the bar in any position of cut by loosening the four binder bolts, tightening one gib screw and



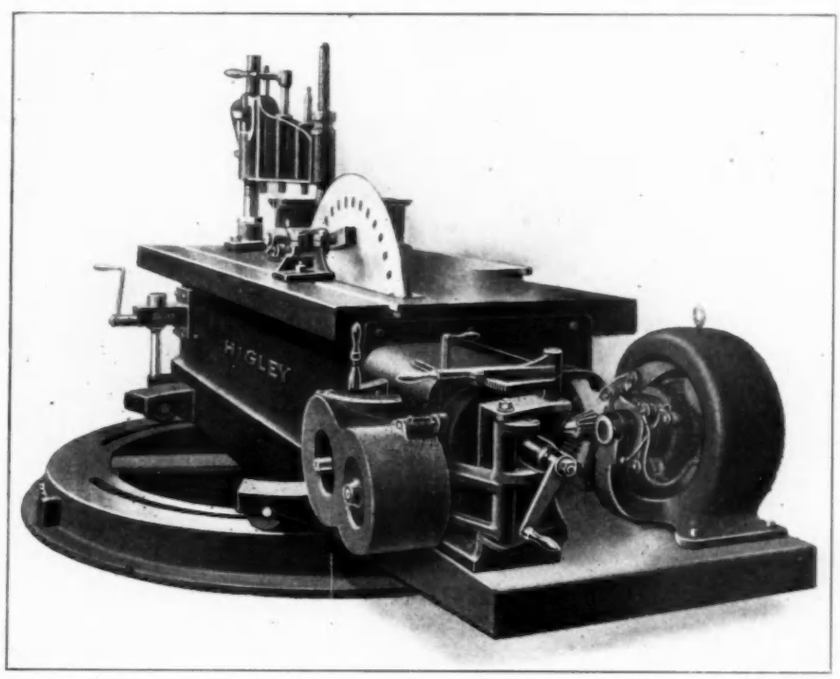

18-INCH MOTOR-DRIVEN SLOTTER

starting the motor. This allows the ram to carry the guide to the desired position where it can be locked.

Work tables have circular, in and out, and cross feed, by hand or power, and automatic or variable, as desired. The circular table is graduated and has a friction locking device to be used when taking cross or transverse cuts.

## A Cold Saw with Friction Feed

The Higley Machine Company, 91 Liberty street, New York has recently brought out a new feed mechanism for its table saws, the general arrangement being shown in the accompanying cut. It consists of two friction disks having ample bearing surfaces and which are held together by a powerful spring, the tension of which can be regulated to suit the rate of feed desired.




A COLD SAW WITH FRICTION FEED

The action of this feed is entirely automatic, being controlled by the resistance of the cut, and when properly adjusted it will relieve itself, instead of being forced ahead at a speed injurious to the blade. In connection with these friction feed disks a set of change gears are used by which the maximum feed can be set at ½, 1 or 1½ inches per minute. The gear box is self contained and the changes are made by the handle shown on top of the graduated arc. This combination of the friction disks and change gears gives a range of automatic feeds from 0 to 1½ inches per minute.

The cut shows the table type saw when mounted on a turntable. The machine is revolved by hand and may be clamped in any position in an arc of ninety degrees.

## Improved Drop Hammer

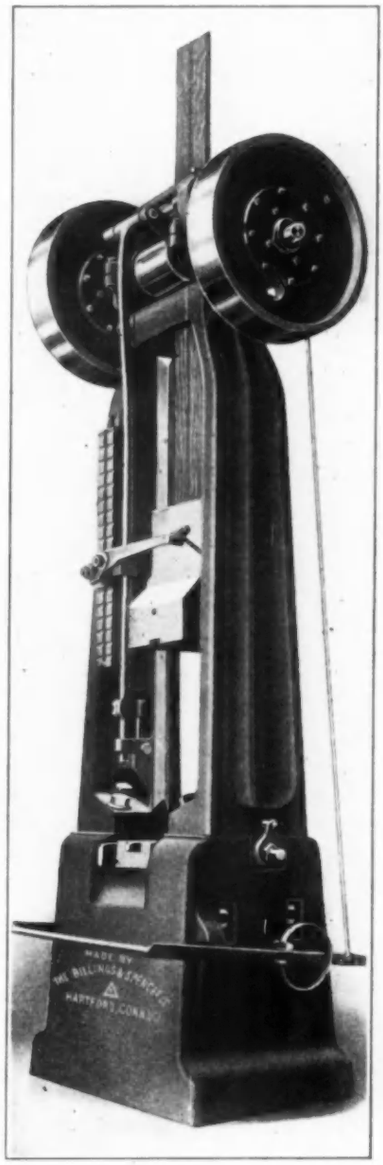
Modern manufacturing demands heavier work in all departments, and the forging plant has in many cases outgrown the lighter hammer of a few years ago. To meet the new condition, and as a result of experience in its own plant, the Billings & Spencer Company, Hartford, Conn., has brought out a new drop hammer, known as model C.

An improved board-clamp catch-up is employed, which does away with the latch and connections at the side for holding up the ram. This board clamp is of an entirely new design, and is located at the extreme top of the machine above the friction rolls or lifting device. This makes it impossible for oil to get between the clamps and board, which has heretofore been the cause of much inconvenience where board clamps have been used. Positive action is assured in the clamps by the operation of cams or eccentrics controlled by a foot lever attached to the base of the machine.

Another feature is a novel adjustment of the rear friction roll by means of an eccentric, a duplicate of that used in engaging the front friction roll, the two rolls, with their eccentrics being interchangeable. By this means of adjustment a true alinement between the lifting board and rolls is always preserved.

A new form of bronze bushing is introduced on the eccentrics bearings, which is easily and quickly removed and replaced. The same eccentric adjustment is also employed on the rear board clamp. These adjustments of the rear friction roll and rear board clamp, are made by means of bars attached to the eccentrics and running down parallel to the uprights to within easy reach of the operator on the floor. An improved method is also employed in attaching the head to the uprights.

The uprights used on the new model are specially designed to reduce the liability of breakage, the distribution of metal being such as to afford the maximum strength. The cross-section of the uprights is that of a letter V, the apex forming the guide for the ram with a longitudinal rib running its entire length to add strength. An important feature in the construction of this machine lies in the fact that the uprights remain solid throughout their lengths, no weakening perforations being necessary in the placing of attachments. An improved adjust-



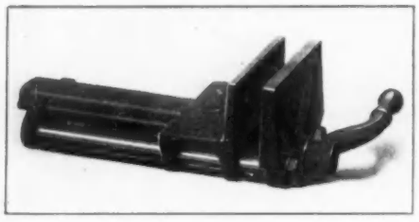

IMPROVED DROP HAMMER

ment for the uprights is employed at the junction of the base and uprights.

The releasing lever attached to the outside of the left-hand upright has an improved adjustment. This adjustment is in the form of a modified rack, intervals of 1½ inches allowing the ram to be released at any desired hight.

## A Parallel Bar Vise

This vise differs from all others in that the parallel bars of the sliding jaw pass through widely spaced bearings on the stationary jaws. They are connected at their rear end by a carrier which travels



PARALLEL BAR VISE

on the outside guide of the stationary jaw, supporting the full length of the sliding jaw at all times. It has a positive grip and holds work securely.

The whole design of the vise is simple and durable. It is made with 8- and 10-inch jaws by the Massey Vise Company, 176-178 South Clinton street, Chicago, Ill.

## The Hoefer Hack Saw

The most important feature of this saw is that a very uniform pressure is main-

THE HOEFER HACK SAW

tained on the saw blade during the forward stroke, while on the return stroke the weight, due to the method of pivoting of the connecting arms, lifts the blade from the work. When the cut is completed, the saw automatically lifts from the work and stops.

The saw is made in two sizes: No. 1 cutting up to 4½ inches round or square stock and No. 2 up to 6x8 inches. The floor rest is furnished with each saw and a motor can be easily attached. It is made by the Hoefer Manufacturing Company, Freeport, Ill.

## A Novel Twist Drill with a Strong Tang

The problem of broken tangs and the many attempts to get away from this difficulty or to enable the further use of the drill after it occurs, has been attacked in a new way. The drill shown is made from a flat bar of high-speed steel, twisted rather closely at one end and with a coarse twist on the cutting end.

A NEW TWIST DRILL

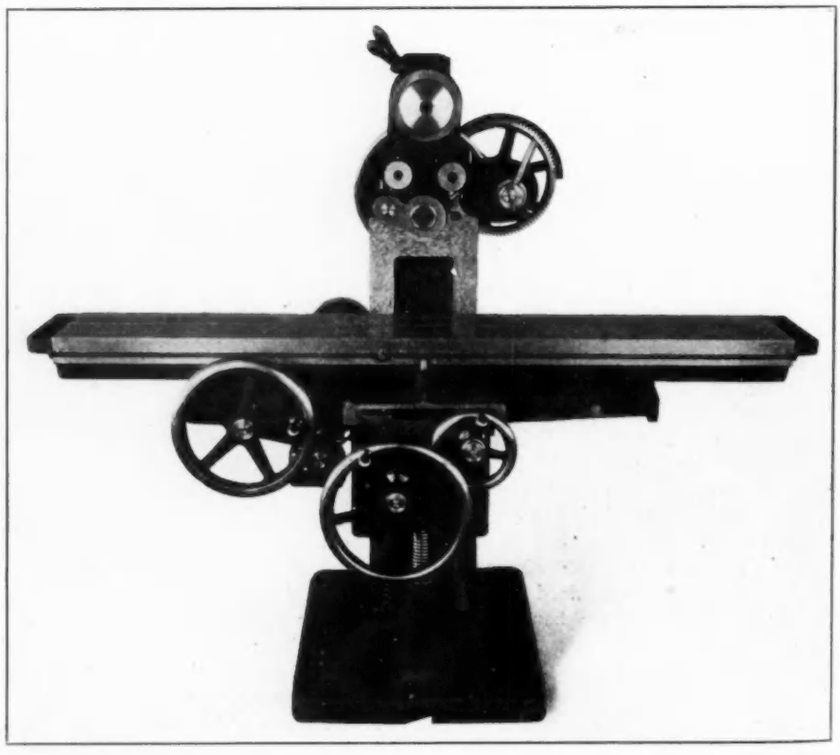
The shank is formed on the closely twisted end, which makes a very strong tang and gives sufficient bearing to hold well in a regular socket without the use of special chucks or collets. The twisted shank is said to give a good grip in the socket, the angle of the twist being designed to resist the combined end pressure and torsional strains due to drilling at high speed and with heavy feeds. Severe tests have been made and all reports have been favorable, both as to cutting and driving qualities. The small amount of steel necessary and the absence of special shanks or holders makes it an economical drill to manufacture. It is made by the Hackett High Speed Drill Company, 90 West street, New York.

## A Milling Machine with Extra Long Feed

The illustration shows a milling machine built to meet the demand for a machine having greater length of table feed than usual, while it is in other particulars similar to the No. 15 plain milling machine, built by the same firm.

In this machine the slide is 62 inches long and is driven by a hardened steel worm which engages with a spiral square thread rack in one piece with the slide. The table has an automatic feed of 60 inches and has a bearing in the saddle of 40 inches.

These millers are built by the Garvin Machine Company, New York.

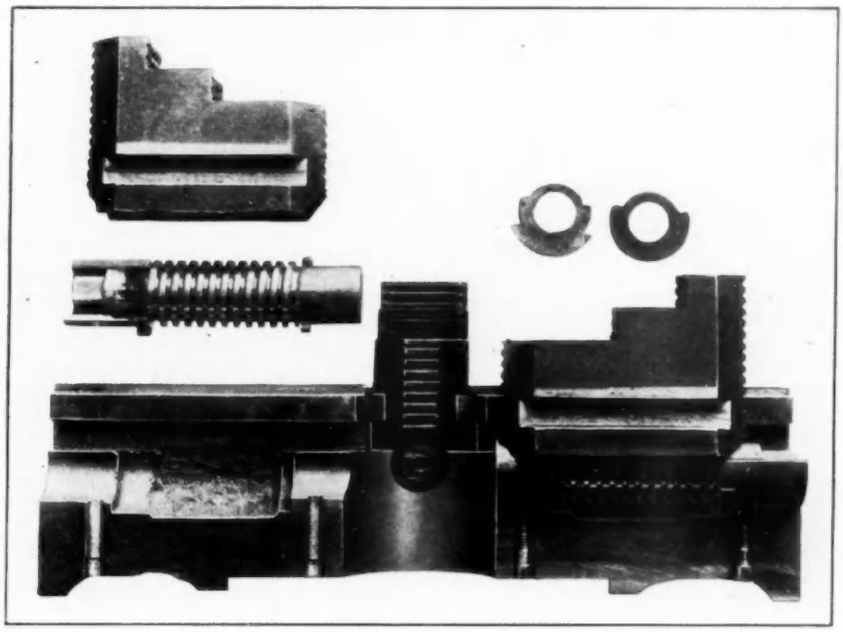


A MILLING MACHINE WITH EXTRA LONG FEED

## A 4-Jaw Independent Chuck

The half-tone shows an independent chuck in which some novel features have been incorporated.

Instead of being seated in half bearings only the screws are journaled at each end in hardened steel bushings, which not only embrace the reduced portion at each end of the screw, keeping it in line with the jaw, but also take the end thrust. When worn, these bushings are easily adjusted or replaced. The screws are made of spindle steel and the bodies of gray iron. The bodies are also provided with T-slots between the jaws.



A 4-JAW INDEPENDENT CHUCK

These chucks are manufactured by the Cincinnati Chuck Company, Cincinnati, Ohio.

## A Heavy Gap Lathe

The halftone shows a lathe built for refinishing car-axle journals with the wheels in place. It can also be used to finish the wheel fits on axles.

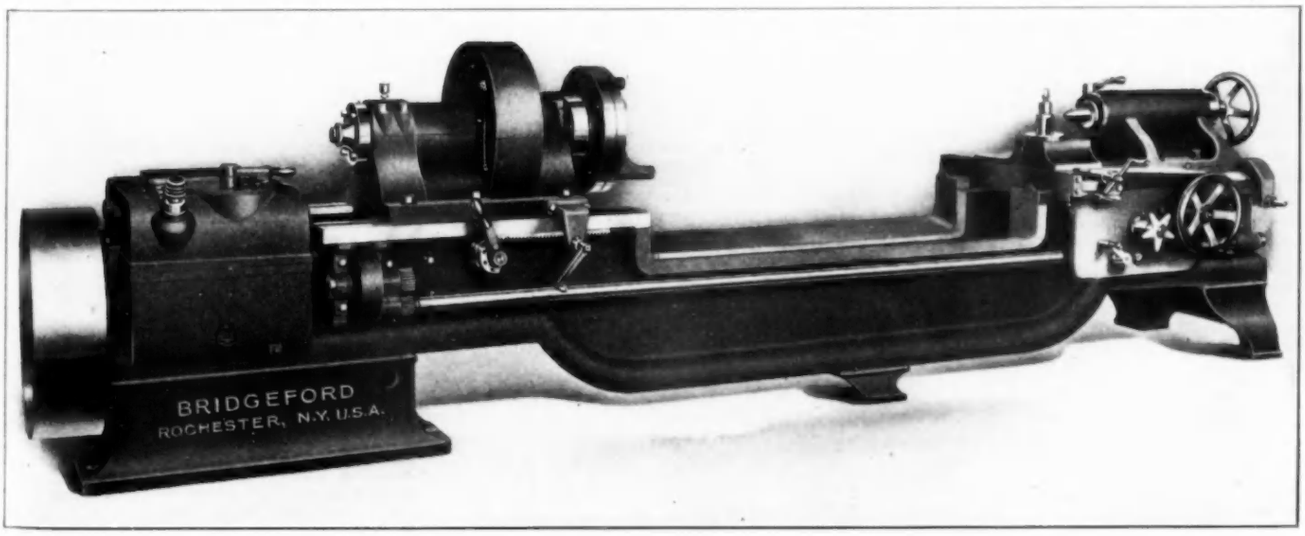
Power is applied through a single pulley as shown and a speed variator permits three speeds to be derived therefrom. The speed changes are accomplished by shifting levers within easy reach of the operator. The distance between the centers is 8 feet and 4 inches; the swing over the ways is 27 inches; over the carriage 14 inches, and in the gap 45 inches. The machine weighs 15,500 pounds, and is built by the Bridgeford Machine Tool Works, Rochester, N. Y.

## Convention of the National Society for the Promotiom of Industrial Education

The National Society for the Promotion of Industrial Education will hold its annual meeting at Atlanta, Ga., November 19, 20 and 21. A banquet will take place on the evening of Thursday, November 19, at which Asa C. Candler, president of the Atlanta Chamber of Commerce and president of the Georgia State branch of the society, will preside. Industrial education as it relates to the prosperity of the country will be discussed by eminent men representing the educational and industrial interests of the various sections of the country. Governor Hoke Smith has accepted an invitation to extend the welcome of the State. Other speakers are Dr. Elmer Ellsworth Brown, United States Commissioner of Education; Hon. James Wilson, Secretary of Agriculture; Andrew Carnegie; and the president of the National Society for the Promotion of Industrial Education, Dr. Carroll D. Wright, President of Clark College, of Worcester, Mass., and formerly United States Commissioner of Labor.

Among the speakers for the second evening are: President E. A. Alderman, of the University of Virginia, Charlottesville; Mrs. Frederick Nathan, of New York, vice-president of the National Consumers' League; Hon. G. Gunby Jordan, president of the Eagle and Phenix Mills, of Columbus, Ga.; John Mitchell, vice-president of the American Federation of Labor; Robert C. Ogden, of New York, president of the Southern Education Board; and L. D. Harvey, of Menomonie, Wis., president of the National Education Association.

An exhibition of trade-school work from all parts of the United States will be one of the features of the convention.




A HEAVY GAP LATHE

This exhibition is being prepared under the direction of Prof. K. G. Mathewson, president of the Georgia School of Technology, Atlanta.

## An American Exhibition in London

An American exposition for which all the exhibits will be taken from this country, will be held in the fine grounds and buildings of Earl's Court, London, next year, from May to October, under the title of The Golden West and American Industries Exhibition.

It is 20 years since the first and only purely American exposition was held in England upon the same site, and it started an era of export commerce for this country that has since grown to large proportions.

One great advantage of Earl's Court is its location in the center of the dense population of London. It is estimated that 5,000,000 people a week can reach Earl's Court at a nominal price from any section of the great city by quick transit lines, such as underground railway, tramways, busses and electric cabs.

The commissioner in charge of the work is John W. Ryckman. Temporary headquarters of the commission have been established at the Ansonia, Broadway and Seventy-third street, New York.

## Business Items

The Cutler-Hammer Manufacturing Company, of Milwaukee, has secured full control of the reorganized National Battery Company, of Buffalo, N. Y., which recently passed from the hands of a receiver.

## Trade Catalogs

Gisholt Machine Company, Madison, Wis. Circular of vertical boring and turning mills. Illustrated.

Hendey Machine Company, Torrington, Conn. Catalog of engine lathes. Illustrated, 112 pages, 6x9 inches, paper.

The Robinson Tool Works, Waterbury, Conn. Folder illustrating and describing drill grinder and cutter grinding attachment.

The Burke Machinery Company, Cleveland, Ohio. Circulars illustrating and describing pressure pump and cutting-off saw.

Hackett High Speed Drill Company, 90 West street, New York. Catalog No. 4 of high speed drills. Illustrated, 8 pages, 6x9 inches, paper.

Niles-Bement-Pond Company, 111 Broadway, New York. Catalog describing Niles boring mills. Illustrated, 48 pages, 9x12 inches, paper.

Morse, Williams & Company, Philadelphia, Penn. Catalog describing Hindley worm gearing and Hindley spirals. Illustrated, 110 pages, 7x9 inches, paper.

Hammacher, Schlemmer & Co., 4th avenue and 13th street, New York. Catalog No. 355, of tools and supplies. Illustrated, 1148 pages, 5½x7½ inches, cloth.

The Emerson Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 3706, illustrating and describing electric buffing lathes. Bulletin No. 3135 on single-phase induction motors.

Hamilton Machine Tool Company, Hamilton, Ohio. Bulletin No. 47, illustrating and describing 24-inch spur geared planer, and Bulletin No. 54, illustrating and describing variable speed planer.

C. W. Leavitt & Company, 220 Broadway, New York. Pamphlet giving description and particulars of the Girod electric furnace for the manufacture of steel. Illustrated, 20 pages, 5½x9 inches, paper.

The Bristol Company, Waterbury, Conn. Bulletin No. 91, describing recording thermometers, Class I. Illustrated, 12 pages, 7½x10½ inches. Bulletin No. 93. Recording thermometers, Class III. Illustrated, 12 pages, 7½x10½ inches.

## Business Opportunities

The Orange (Tex.) Crate and Box Company will establish sawmill.

The Mauch Chunk (Penn.) Silk Company will erect an addition to mill.

J. H. & S. B. Marshall, Evergreen, La., will establish a broom factory.

The Reliance Motor Cycle Company, Owego, N. Y., will enlarge its plant.

The Rochester (N. Y.) Box and Lumber Company will erect a new plant.

The Byromville (Ga.) Manufacturing Company will erect a planing mill.

David Scott, Athens, Ga., will rebuild cotton gin recently destroyed by fire.

John H. Ray & Son, Greenwich, N. Y., is erecting a new carriage factory.

The Frazier Stove Company, Indianapolis, Ind., will erect a factory at Anderson.

The Monahan Vehicle Company, Olneyville, R. I., will build a three-story addition.

A machine shop 100x100 feet will be erected for the Erie (Penn.) Foundry Company.

The Bridgeport (Ala.) Woodenware Company is planning to increase capacity of plant.

The Vredenburgh Sawmill Company, Pine Hill, Ala., will rebuild plant recently burned.

Burke & Gregory, Norfolk, Va., are erecting a new building to be used as a book bindery.

The Godel Packing Company, Peoria, Ill., will reconstruct plant recently damagen by fire.

The Stewart Company, Moundsville, W. Va., manufacturing enameled ware, will enlarge plant.

Dalton & Clark, of Winnfield, La., contemplate establishing a stave factory in Alexandria.

The Fuller Combing Gin Company, of Charlotte, N. C., will erect a plant at East Lake, Tenn.

C. C. Knight Company, wholesale iron, Philadelphia, Pa., will have a six-story factory erected.

George Brown, of Norfolk, Va., will establish a barrel, crate and veneer factory at Boulevard, Va.

E. M. Lewis, of Anniston, Ala., contemplates establishing a cotton-seed oil mill at Aliceville, Ala.

The Peterson Piano Company, Moline, Ill., has awarded contract for the erection of a new dry kiln.

The Newton (Ga.) Balance Valve Company will put up a plant for the manufacture of its valves.

The crate and box factory of E. J. Baird, Gainesville, Fla., was destroyed by fire. Loss $10,000.

The T. B. Townsend Brick and Contracting Company, Zanesville, Ohio, will erect a $40,000 addition.

The Sanders Cotton Oil Mill has been incorporated at Tuscaloosa, Ala. J. W. Sanders, president.

An addition is being built to the plant of the Malleable Iron and Chain Belt Company, West Allis, Wis.

The plant of the Cosmosdale (Ky.) Cement Company was burned with a loss of about $2,000,000.

The Nevada Motor Car Company, of Reno, Nev., it is said, will erect a factory at Council Bluffs, Iowa.

It is reported that F. A. Marsh & Co., Belvidere, Ill., will erect a $40,000 addition to its canning plant.

Palmer Bros., Cos Cob, Conn., manufacturers of motors, are contemplating the enlargement of their plant.

The plant of the Baker Egg Case Company, Urbana, Ohio, was destroyed by fire, causing a loss of $60,000.

John Bouchard & Sons Company, Nashville, Tenn., will install a plant for the manufacture of ice machinery.

Southern Spring and Mattress Works, New Orleans, La., will rebuild plant which burned a short time ago.

Contract has been awarded for two additions to the plant of the Republic Rubber Company, Youngstown, Ohio.

The Interstate Lumber Company, Columbus, Miss., will, it is said, establish a planing mill at a cost of $10,000.

The Heine Boiler Company, St. Louis, Mo., has applied for permit to erect a manufacturing plant to cost $100,000.

William Harland & Son, varnish manufacturers, New York, will erect a factory at Buffalo, to cost about $350,000.

Jenkins Bros., New York, has awarded contract for the construction of a factory building at Elizabeth, N. J., to replace the plant of the Jenkins Rubber Company, recently destroyed by fire. This company is controlled by Jenkins Bros., which manufactures valves, etc.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m. October 12 for guy derricks and hoisting engines, steam hammer, universal grinding machine, upright drills, engine lathe, air drills, generator and engine, electrical supplies, wire, jacks, chisels, hammers, wrenches, vises, portable forge, valves, lag screws, rivets, leather belting, etc.; as per Circular No. 468.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids as follows: October 6—Grease cups (schedule 363), gages (schedule 362), hoist (schedule 387), electrical supplies (schedules 358, 361, 377), drills, files, emery wheels, screws, grindstones (schedule 373), pipe and fittings (schedule 360), chipping hammer, riveting hammer, drilling machines, drilling and reaming machine (schedule 354), repair parts for pneumatic tools (schedule 373). October 20—Pipe fittings (schedule 369), steel (schedule 368), hack saw blades (schedule 367), pipe cutters, screws, machine screw taps (schedule 367). October 27—Upright drills, nipple and pipe mill machines (schedule 384).


# Want Advertisements

*Rate 25 cents per line for each insertion. About six words make a line. No "advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or ind.-*

*vidual charging a fee for "registration," or a commission on wages of successful applicants for situations.*

## Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Small, accurate drill jigs and dies built to order. R. Rosner, Madison, Wis.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Orders for brass goods. Castings and finished product. Box 486, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

For any machine or small tools firms not yet represented in France please apply to "Société Francaise de Machines-Outils, 3, Rue Arsène Houssaye à Paris."

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Apparatus for separating liquids from gases or vapors, patented in America, 1000 apparatus sold in Europe. Patent to be sold in America. Apply H. & W. Pataky, Patentbureau, Berlin W. Leipzigerstrasse 112.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Streets, New York City.

Specialty wanted by manufacturing firm in Great Britain. Will either buy English patents right out or work on royalty. Have latest automatic, capstan and press work plant. Send all particulars to Steel & Screw Co., Ltd., Small Heath, Birmingham, England.

Wanted—Patented article that can be used in machine shop boiler room, or engine room. Must have merit. We possess finest facilities for marketing, having a large force of traveling men in this country, and agents in nearly every large city in Europe, who call upon steam users and machine shops. Liberal contract. Highest of references. Address Diamond Power Specialty Co., 236 Fort St., W., Detroit, Mich.

Patent & Designs Act, 1907—A leading firm of machine tool makers are prepared to undertake the manufacture for patentees of any suitable articles (preferably machine tools), which must be made in Great Britain under the provisions of the above act. Apply Box 474, AMERICAN MACHINIST.

## Situations Wanted

*Classification indicates present address of advertiser, nothing else.*

CONNECTICUT

High grade superintendent wants good position. Up in recent shop methods in all departments and cost systems. Energetic, executive, a handler of help and a producer. Box 492, AMERICAN MACHINIST.

ILLINOIS

Draftsman and designer, 10 years' experience, desires position; best of references. "F. H.," 436 Jackson Boul., Chicago, Ill.

Designer, with experience on special machinery and machine tools, wants employment near Chicago. Box 478, AMERICAN MACHINIST.

Situation wanted by all-round practical draftsman, 28, reliable and steady. Good on design, system, clear and accurate drawing. Box 465, AMERICAN MACHINIST.

Position as superintendent, Southern city preferred, by man who is thoroughly competent to handle machine shop and foundry on any class of work. Employed at present, but desires to make a change. Box 464, AM. MA.

INDIANA

For an efficient and experienced general foreman or assistant superintendent for a machine shop, address "R. S. C.," 1324 W. 30th St., Indianapolis, Ind.

MASSACHUSETTS

A toolmaker on jig, fixture and special tools for the rapid production of duplicate parts. Desires change; could take charge of small department. Box 481, AMERICAN MACHINIST.

Position wanted by experienced mechanical engineer where there is opportunity to produce results. Graduate Massachusetts Institute Technology, married, aged 32, good executive ability. Large experience developing machinery and handling men. Six years' in present position. Will go anywhere. Henry R. Gilson, 255 Atlantic Ave., Boston, Mass.

MICHIGAN

Tool designer, inventive and practical toolmaker, technical education, energetic and systematic, desires change. Box 488, AM. MA.

NEW JERSEY

Machinist foreman, well experienced, wishes position as foreman over all kinds of machine hands. Box 453, AMERICAN MACHINIST.

Position as draftsman by a steady, reliable young man; seven years' shop and drafting experience. Box 454, AMERICAN MACHINIST.

Mechanical engineer, eight years designing and erecting power plants, shop, drafting, experience executive ability. Box 483, AM. MA.

Mechanical engineer, designing draftsman, graduate, nine years' experience rolling mill, special machinery; desires change. Box 490, AMERICAN MACHINIST.

A young man, at present employed, desires a position as superintendent, manager or general foreman, or assistant to same, in manufacturing concern. Can do own drafting if a small place. Will consider a concern just starting or an old established firm. Thoroughly reliable and honest. State particulars, material manufactured, size of plant, location, etc. Triflers and agents ignored. "R. R.," care AMERICAN MACHINIST.

NEW YORK

Draftsman, expert mechanical, desires New York City position. Box 494, AMERICAN MACH.

By experienced machine designer, automobile work preferred. Box 470, AMER. MACH.

Practical mechanic and machine designer to take charge of small shop or drafting department. Box 469, AMERICAN MACHINIST.

Mechanical draftsman desires position. Seven years' shop and eight years' office experience Technical graduate. A-1 reference. Box 471, AMERICAN MACHINIST.

Expert catalog illustrator of mechanical subjects; also detailer. Technical education, eight years' experience, willing to go anywhere. Box 477, AMERICAN MACHINIST.

Draftsman and designer, technical graduate, 10 years' mechanical and electrical experience, generators, switches, gasolene engines, desires position. Good references. Box 479, AM. MA.

Wanted—Position as foreman or working foreman of toolroom by a practical, up-to-date man; 12 years' experience at punches, dies and manufacturing; three years as foreman; age 28; desires change. Box 473, AMERICAN MA.

Engineer, experienced in shop management and the design and manufacture of cranes, buckets, industrial cars, structural work, etc., wishes to change. At present chief engineer of structural and machine shops. Box 467, AMERICAN MACHINISTS.

Master mechanic, 18 years' experience on interchangeable work, machine tools, watches, sewing machines, guns, bicycles and electrical apparatus; also designer of special machinery. Nine years with present concern. Box 459, AMERICAN MACHINIST.

Designer, age 31, shop practice, graduate engineer, 11 years' experience fine apparatus, fixtures, automatic, special machinery, experimental work. Inventive, good judgment, very able man. Go anywhere. Address Box 487, AMERICAN MACHINIST.

An American, 30 years old, wants to locate in some Western territory as manager of sales or Western representative. Has 12 years' selling experience and can furnish bank and commercial references. Salary and commission arrangement preferred. Box 493, AM. MA.

Mechanical engineer, Stevens (29), Jun. A. S. M. E. Five years' experience in shop work, mill construction, designing special machinery and piping layouts for power plants. Desires suitable position in the East. Address "Factory Engineer," care AMERICAN MACHINIST.

Mechanical engineer is open for engagement as superintendent, master mechanic or general foreman; technical education; large experience as designer and manufacturer of interchangeable machinery, sheet metal goods, electric instruments, typewriters, etc. Box 491, AMERICAN MACHINIST.

Draftsman, mechanical, young man (22), desires position with reliable firm located in New York State or vicinity; best of references as to competency, etc.; four years' practical shop experience in electrical and marine engine work; can also act as general outside man. Box 482, AMERICAN MACHINIST.

Engineer, aged 31, technical graduate, expert designer and inventor of automatic and special machinery, jigs, fixtures and tools; worked seven years as machinist and eight years as draftsman. Has held position as head draftsman and assistant master mechanic; wishes position. A-1 reference. Box 472, AM. MACH.

Superintendent wants position with large, responsible firm; practical and theoretical man, energetic and diplomatic, up-to-date on modern systems, thoroughly experienced at toolmaking, machine and instrument making, brass foundry, pattern making, plating, polishing and woodworking; knowledge of material; productive and inventive. Address "Reliable," AMERICAN MACHINIST.

PENNSYLVANIA

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

## Help Wanted

*Classification indicates present address of advertiser, nothing else.*

CANADA

Agents wanted for Canada to represent first-class machine tool firm. Please apply to Société Francaise de Machines-Outils, 3, Rue Arsène-Houssaye, Paris.

Wanted—Superintendent for a Canadian factory. Company has large government contracts and up-to-date plant. Applicant should be all round machinist and draftsman, familiar with small interchangeable work, having thorough knowledge of punch press work. Large salary to right man. State age, experience and salary wanted, give references, address direct. Sutherland Rifle Sight Co., New Glasgow, N. S., Canada.

CONNECTICUT

General foreman, must be first class machinist, good executive and familiar with modern shop methods. State age, experience and salary expected. Steady employment and excellent chance for advancement to the right man. Box 480, AMERICAN MACHINIST.

INDIANA

A patternmaker for gasolene engine work, good wages. Box 484, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Draftsman with fair amount of experience on pumping machinery. Write fully, stating experience and wages expected to start, and giving reference. Box 466, AMER. MACH.

NEW YORK

Foreman for machine stoneworking factory. Must be orderly and systematic and able to show results. Address "C. S. A.," Box 476, AMERICAN MACHINIST.

Toolmakers wanted, $3.00 per day. Reply stating fully age, education, experience, past employers, work done, married or single, habits and give references. Box 475, AMER. MACH.

Wanted—A machine tool salesman of experience to work from New York or Philadelphia. Should be a practical mechanic of good address. Apply with handwritten letter, giving age and experience. Box 485, AMER. MACH.

Wanted—An intelligent and experienced machinist and toolmaker to act as instructor in advanced machine work in evening classes at Pratt Institute three evenings a week. Apply, stating age, experience in detail and training to W. J. K., Pratt Institute, Brooklyn, N. Y.

OHIO

Wanted—A superintendent and shop manager, who understands high-grade machine tool work in the milling machine class. Will sell part interest to the right man. Business established six years, and thoroughly advertised. Box 436, AMERICAN MACHINIST.

PENNSYLVANIA

Draftsman—An Eastern college has a position open for a technical graduate as junior instructor of mechanical drawing. In answering state age, education and drawing office experience with references. Box 468, AM. MACH.

Mechanical engineer wanted in an iron foundry and manufacturing plant to take general charge of the machinery, buildings and power; one having some previous experience in the valve business or kindred lines preferred. Replies must state experience fully and will be treated confidentially; give age, salary expected, etc. Box 489, AMERICAN MACHINIST.

FOREIGN

Required specialist for Russia (Baltic provinces) to make the installation and to survey the manufacturing of enameled cast-iron tanks and other enameled cast-iron articles; also utensils for water conducting. Address letters to: Sub-Lit, R.S.M., care L. & E. Metzl & Co., Morskaja 11., St. Petersburg, Russia.

# For Sale

*Classification indicates present address of advertiser, nothing else.*

For Sale or Rent—Foundry, machine and wood shops with machinery in town of 5000. Box 227, Bergen, N. Y.

Steam Plant for Sale—22x48 Wetherill Corliss engine. Cost $3350; sell $1500. Two tubular boilers, 66"x16'. Cost $1000 each; sell $450 each. F. O. B. cars Chester, Pa. All in good condition. Keppel & Co., Chester, Pa.

For Sale—The complete outfit for manufacturing the best granulated and plastic metallic packing in the world for steam, air and ammonia. Established 12 years. No experience required. Just the thing in connection with a machine shop. Address P. O. Box 24, South Stillwater, Minn.

Auction sale of all the machinery, tools, etc., of the Fishkill Boiler Works, Fishkill Landing, N. Y., consisting of set boiler rolls 9'x6', Allens hydraulic riveting machine, Hillis & Jones 16' plate planer, 6' set boiler rolls, heavy double end boilermakers' punch and shear, 48", made by Kent; and a large lot of shafting, pulleys, small boilermakers' tools and new supplies on Wednesday, October 7, 1908, at 11:30 a.m. Catalogs with full lists sent on application to R. W. Doughty, P. O. Box 794, Fishkill-on-Hudson, N. Y.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horse-power vertical and 3, 5, 8, 10, 12, 16 and 20 horse-power horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser Box 366, AMERICAN MACHINIST.

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# Classified Index to Articles Advertised

**Abrasive Materials**
Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I
Carborundum Co., Niagara Falls, N. Y.
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Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O
Vitrified Wheel Co., Westfield, Mass.

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**Alundum**
*See Grinding Wheels.*

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Morse Twist Drill & Machine Co., New Bedford, Mass.
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Skinner Chuck Co., New Britain, Conn.
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Dixon Crucible Co., Joseph, Jersey City, N. J.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

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**Belt Filler**
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Wallace Supply Co., Chicago, Ill.

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*See Hoists, Hand.*

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Lucas Mach. Tool Co., Cleveland, O.
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Motch & Merryweather Machinery Co., Cleveland, O.
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Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
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Mitts & Merrill, Saginaw, Mich.
Newton Machine Tool Wks., Inc., Phila., Pa.
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Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

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*See Grinding Wheels.*

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Fay & Scott, Dexter, Me.
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New Haven Mfg. Co., New Haven, Conn.
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Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
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Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

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Brown & Co., R. H., New Haven, Conn.
Celfor Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland O.

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Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
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Whitney Mfg. Co., Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.
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Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
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Harrington & Son Co., Edwin, Philadelphia, Pa.
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Hardinge Bros., Chicago, Ill.

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Caldwell, Son & Co., W. H., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
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Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
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Bury Compressor Co., Erie, Pa.
Clayton Air Compressor Works, New York.
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Ingersoll-Rand Co., New York.

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Merritt, Jos., Hartford, Conn.
Owen Machine Tool Co., Springfield, O.
Schaeffer Mach. Wks., Phila., Pa.
Turner Mach. Co., Danbury, Conn.

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General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Link-Belt Co., Philadelphia, Pa.

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*See Grinding Wheels.*

**Cotters**
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LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
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Prentiss Tool & Supply Co., New York.
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Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

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Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

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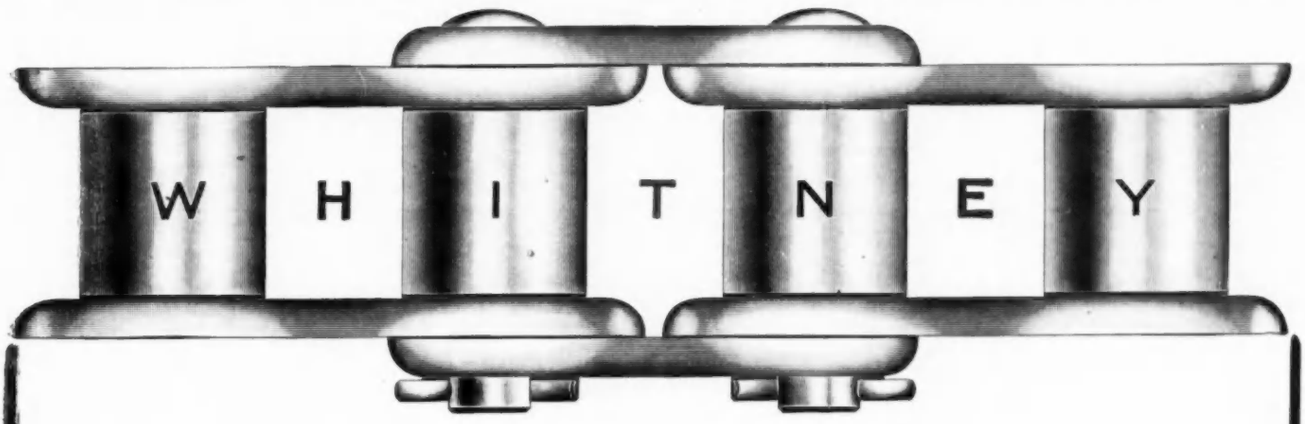
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.

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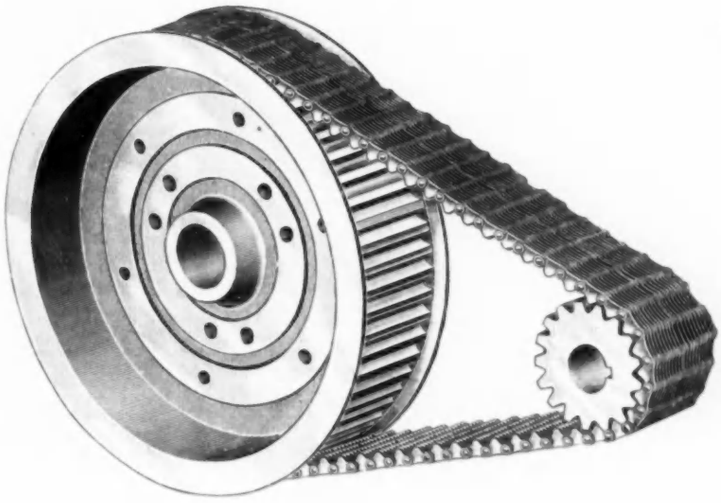

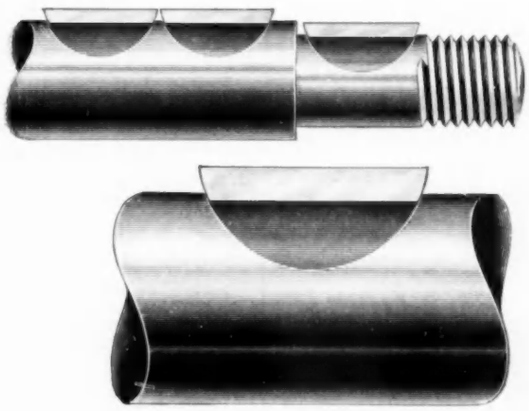

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Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

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Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

**Drilling Machines, Radial**

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Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hilbert Mach. Co., Cincinnati, Ohio.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Newton Mach. Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

**Drilling Machines, Rail**

Foote-Burt Co., Cleveland, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Standard Tool Co., Cleveland, O.

**Drilling Machines, Turret**

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Niles-Bement-Pond Co., New York.

**Drilling Machines, Upright**

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Celfor Tool Co., Chicago, Ill.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Mach. Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry Co., Chicago, Ill.

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Morse Twist Drill & Mach. Co, New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
bley Machine Tool Co., South Bend, Ind.
Slate Mach. Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

**Drills, Center**

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

**Drills, Electric**

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

**Drills, Flat**

Celfor Tool Co., Chicago, Ill.
Lincoln Williams Twist Drill Co., Taunton, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

**Drills, Hand**

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Hisey-Wolf Mach. Co., Cin., O.
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U. S. Electrical Tool Co., Cincinnati, O.

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Rogers Works, John M., Gloucester City, N. J.
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Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
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Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
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Hisey-Wolf Mach. Co., Cincin., O.
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Roth Bros. & Co., Chicago, Ill.
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Crocker-Wheeler Co., Ampere, N. J.
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Dickinson, Thos. L., New York
Niles-Bement-Pond Co., New York
Norton Co., Worcester, Mass.
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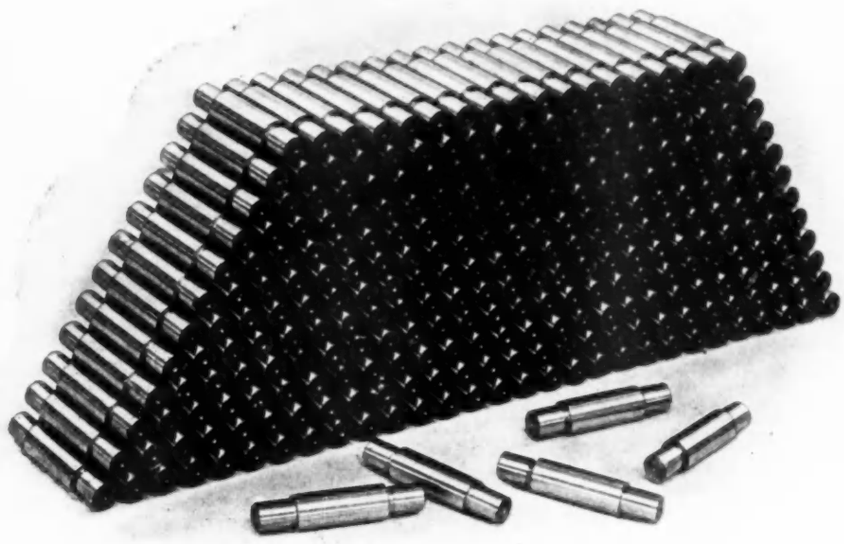

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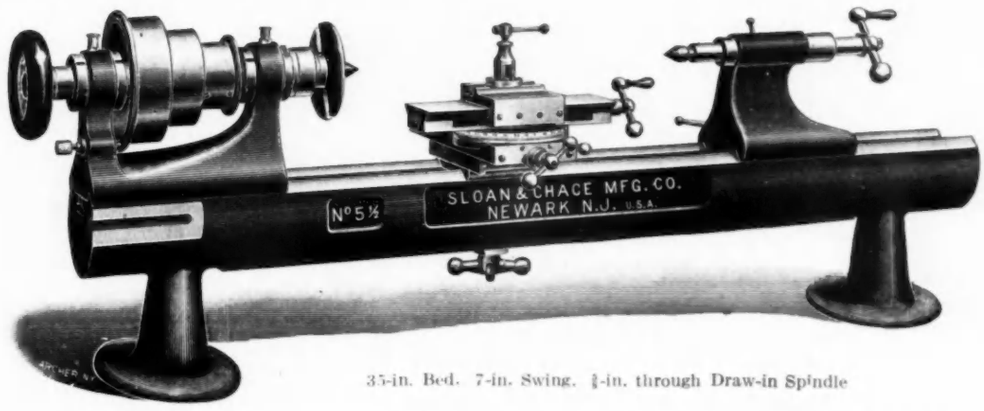


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